JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

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EDITORIAL NOTES.

Round the Town in Coronation Week.

THERE is too much "Coronation" in the air this week to allow of the subject being totally ignored in these columns, although, as a matter of fact, the great function and the popular rejoicings attending it do not touch, except at one point, the class of subjects habitually discussed here. It is generally understood that the consumption of gas for the illuminations will not make up for the reduced demand due to the closing of shops and houses of business for two days. Indeed, it is still doubtful in suburban localities whether the show of illuminations will after all amount to anything very extraordinary. Many owners of frontages seem to be contenting themselves with small displays, thinking no doubt that it is not worth while to make a big outlay for a show that must begin so late. The season of the year, too, is unfavourable to illuminations; yet it is gratifying to know that gas remains the first favourite with those who have laid themselves out to create an impression on the public in this way. Not that electricity is neglected—far from it, indeed. The superior advantage of electric incandescent lamps, that they can be festooned in the graceful line of the catenary curve, is well exemplified in many striking cases. The daylight decorations of all English towns, with London at the head, are such as to convince the most captious of critics that there really has been a great advance of late years in the national taste for civic pageantry. Perhaps it would be truer to say that the ancient glories of the realm in this regard have been revived. For Old England was gay enough once upon a time, as all readers of her history well know. For many long years, however, the "knack" of pageantry seemed to have departed from the land. What a hard and gloomy cast of thought in one direction left, a short-sighted utilitariansim choked out. The long Victorian mourning made the land all grey. The towns were built with no provision for any occasional decoration. The idea that the people would ever again care to turn out into the streets and be glad in a civic fashion was unheard of for the lifetime of a generation. Our cities were rebuilt in dull portland stone and terra-cotta of the deepest dye; and the people lost the taste of such pageantry as delighted their ancestors, simply from disuse of exercising it.

Let us hope that civic brightness has returned to stay. The paint-brush has already lightened up many street frontages; and the notion that the only service a street-lamp might be expected to render is to make darkness visible, has suffered an eclipse which it is to be hoped will be permanent. It is amazing what a change for the better can be wrought in the aspect of a town by a little enlightened attention to these points. Remark, for example, the altogether admirable revival that has lately taken place, with astonishing vivacity, of the fashion of shop signs. Most people can remember reading in school histories of the lighter order about the profusion of such signs which struck the visitor to the London of a past day. Every such visitor wrote home about them—usually making fun of their oddity, but sometimes complaining of the noise they made at night when it happened to be windy. The signs disappeared when street numbering came in; and a strong element of the picturesque vanished from our city life. Happily, we have never sunk so low in mere utilitarianism as to number the streets as well as the houses in them; and now the dead uniformity of street numbering has instigated the revulsion already mentioned, and "signs" are in growing favour. In its essence, of course, as a means of arresting attention, the tradesman's sign has never quite fallen into desuetude. The big, glaring facia is a sign—so is the abominable flash-light advertisement. How much better the "Sign of the "Grasshopper," or the "Three Squirrels" of Eighteenth Century renown! Well, these are coming again; and more. The glittering vulgarity of the publican's gas-lamp, as big as a beer-barrel, is not going to remain the one and only representative of the decorative use of gas lighting subordinated to commercial purposes. Dainty lanterns, placed in hammered iron and bronze frames, are appearing one by one over many other street frontages. Of course, the outside hanging shop light is usually a horrible object, of which the best that can be said is that its use is to enable other things to be seen, not to attract attention to itself. Still, they are unnecessarily hideous. The shop sign-lights we are alluding to are of a different class, and are intended to be ornamental in themselves, both by day and by night. Prizes for such designs ought to be offered in Provincial Schools of Art.

The assistance rendered by electricity in improving the appearance of English towns should not here be overlooked. Electricians did not at all understand the work at first—more particularly the "practical" ones who came from America. But the contemporary practitioners of public electric lighting and illumination are very well up in their line. The "Bremer" arc light is a very effective thing indeed, of its kind, and puts gas engineers upon their mettle again, just when they thought the high-pressure incandescent gas-lamps for street use had settled the business. In connection with the employment of incandescent electric lamps for illuminations, also, the electricians have hit on a device which is worthy of attention. They put behind a lamp a reflector which is itself coloured; and this expedient considerably reduces the loss of brilliancy due to coloured lamp-glasses. This and many other ingenious devices will lend their aid to the embellishment of the streets for the Coronation—and, let us hope, for many other popular merry-makings in the coming time. The world has now outlived the stage of thought when the kind of drab civic existence depicted in the dreams of perfervid Socialists passed for the fine flower of civilization. King Edward the Seventh and Queen Alexandra stand, at this moment, for some of those things of heaven and earth which are not included in the Utilitarian philosophy; and of such are most of the things worth living for.

Gas Consumers' Complaints at Perth.

GAS matters in North Britain progress so evenly and prosperously, as a rule, and it is understood so widely that the general municipalization of the Scottish gas industry has been fraught with so many and great benefits to the people, that the affairs of a gas department of a city beyond the Tweed but rarely furnish matter for discussion in these columns. There is, happily, no "history," in short, of the Scottish gas supply to form the subject of controversy. An exception, however, has come under our notice in respect to the city of Perth, where something resembling an old-fashioned "gas agitation" has manifested itself of late, and presented the remarkable spectacle of a number of consumers complaining of the excessive amounts of the gas bills they have been called upon to pay. On the face of it, this is a fact of which some of the ardent advocates of the municipalization of all public services, whose zeal is not according to knowledge, might be recommended to take notice. In theory, of course, nobody ought to suspect for a moment that he is being overcharged by a municipal trading department. This is almost a truism of the controversy upon the "principle." Where there is no trading company with greed of gain for its only rule in business, how can a user of the service provided at the public expense consider himself aggrieved at the charge made upon him? It seems ridiculous that any reasonable person should do so; and the bare possibility of such a proceeding is never so much as considered by the partisans of municipalization who pity their own lot in being served by a company. Yet, in point of fact, human nature is often less, and more, than reasonable. It refuses to be bound in the bonds of a theory of administration; and accordingly we do hear occasionally from different parts of the country about the public complaining as to the quality and price of the gas supplied by a local authority, just as they might of the treatment meted out to them by a company.

In Perth, the complaints of overcharges for gas rose to such a height that the Town Council referred the question to an independent expert—to wit, Mr. Thomas Newbigging.

His appointment over the heads of their own Gas Committee, was undoubtedly a strong action. Usually, a departmental inquiry into a matter of this kind is held to be sufficient; so that the need for independent investigation must have been deemed serious. Nevertheless, the case as it came before Mr. Newbigging did not exhibit a great bulk or weight of evidence. Of a total of 8800 consumers, only 97 had disputed their gas bills in writing. But so experienced a judge of such matters as Mr. Newbigging knows very well that for one person who will go the length of writing to the proper quarter to state the ground of his grievance, many more will cherish a sense of injury which it is highly desirable to allay, if possible, by sympathetic attention to the tale of woe. He had no difficulty in finding and admitting that there had been a general increase in the amount of the gas bills for the last quarter. He even went to the extreme limit permitted by his own position in the general situation, avowing to the complainants whose cases were among the gravest that, assuming the correctness of their own statements, he could not account for the increase in their bills. But that is not to say that the assumption could be made. In all these cases, there was the *primâ facie* evidence of the meter registration to go upon; and it is unnecessary to argue for the difficulty in any case of going behind this fact. Of course, when people, even though as hard-headed by nature as Scotsmen are commonly reputed to be, think themselves overcharged for gas, all the silly old jokes about the lying propensities of gas-meters recur to their minds, and vitiate their judgments. The defender of the character of the meter finds himself from the outset deprived of a common ground upon which he and the man he is endeavouring to bring round to his way of thinking can stand and argue the point out as between friends. And yet it is perfectly true, as Mr. Newbigging told the good citizens of Perth who would not trust their own Gas Department, that the consumer's gas-meter has earned what bad repute it has by its honesty. The only cure for a consumer who will not accept this character of the instrument is the use of a prepayment meter.

It is a little disappointing to find that some of the people of Perth whom Mr. Newbigging interviewed were labouring under the old delusion about air being pumped into the district mains to make the meters go fast; and those who affect to set store by popular notions of the quality of gas supply, may be interested to learn that in Perth, with 25-candle gas, complaints of "bad gas" are common. The same persons naturally also complain of the gas blackening their ceilings. Some busybodies appear to have been acting behind the Manager's back in giving out gratis to consumers burners too large for use with the rich Perth gas. This is childish meddlesomeness, deserving of the sternest condemnation. After attentively studying Mr. Newbigging's report, with some knowledge of the ways of the world outside Perth, we can only conclude that he has completely succeeded in answering the questions he was set to consider. It is extremely gratifying to observe that he awards the highest praise to Mr. M'Lusky, the Engineer and Manager of the Corporation gas-works, for his intelligence, devotion, and good faith. The Manager must have been sorely tried by the campaign of tittle-tattle and "pin-pricking," which seems to have been waged round him by a small minority of the citizens who might have something better to do with their evidently unlimited leisure and their obviously limited common sense. We have given a good deal of space to this Perth affair, not because of its intrinsic importance, which is a negative quantity, but for the sake of the lesson it teaches, that a municipalized gas supply is not necessarily exempt from ignorant and slanderous imputations—not merely on the merits of the service, but also on the good faith of those who are responsible for its proper administration. The technical point of the record lies in the evidence to be read in it—which Mr. Newbigging does not omit to distinguish—that a necessarily high-priced, because highly-carburetted gas is no longer suitable for the manifold uses to which gas is put by a town population.

It was all very well to send out 25-candle gas for consumption by means of the tiny burners which gave Scotland the gloomy appearance after dark that seemed so characteristic of the land. The public had grown so wedded to this style of lighting, and the interior fittings were so skimped and stinted to suit, that there was some force in the objection often raised to proposals for a change, that only gas of the highest possible illuminating power would be of any service at all. Glasgow broke down this objection; and now it is very clear that Perth also would be better off with a gas that might be used freely for gas cooking, and fires, and gas-engines—to say nothing of incandescent lighting, with its small consumption—without frightening the consumers. For there is no use denying that people who avail themselves of gas-cookers and gas-fires, at any rate, must be prepared for an uncertain amount of waste, especially where the handling of these great comforts of civilized life in town is perforce entrusted to domestic servants. These causes, together with a dark and particularly cheerless winter, are among the reasons found by Mr. Newbigging to be adequate to explain so much of the discontent in Perth as might be deemed worthy of respectable regard. The rest of it seems to be the outcome of a discreditable cabal.

Wages in the Federation Coalfields.

At the beginning of last week, Lord James of Hereford, the independent Chairman of the Coal Conciliation Board that deals with questions of wages in the Federated mining districts, made known his decision as to the claim of the coal-owners that wages in those districts should be reduced. Briefly, the position was this: The Board was formed in 1893, after the great strike, and is composed of an equal number of delegates representing the owners and miners respectively. In the event of insuperable disagreement between the two sides, an independent Chairman may be called in; but, until the present instance, the rates to be paid have always been settled by mutual agreement, and the services of the Chairman have not been required. As in every case but one the changes made in wages have been by way of increase, the fact that those changes have been agreed to without resort to arbitration is evidence of the reasonable spirit shown by the coalowners. Now, however, that the boot is on the other leg, and the change demanded is a reduction, a different spirit is being displayed by the men—that is. by the general body of miners, not by their representatives on the Conciliation Board. When the Board met to discuss the owners' demand for a reduction, the miners' delegates agreed to recommend their constituents to accept a 10 per cent. reduction by two instalments—one in June, the other in August; but the men declined to endorse the action of their representatives, who had, therefore, to vote, at the adjourned meeting of the Board, against the proposal that they had agreed was reasonable. It was consequently necessary to call in the independent Chairman, in order that he might give his casting vote. His decision is in favour of the owners, as was, indeed, practically a foregone conclusion. Lord James could not be expected to be any more pro-miner than was Mr. Pickard. Wages will, therefore, be reduced at the beginning of next month by 10 per cent. on standard rates.

It will be remembered that, under the agreement governing the procedure of the Conciliation Board, wages in the Federation districts (where about 300,000 miners are employed, equal to nearly one-half the total number working in the United Kingdom) cannot exceed 60 per cent. above the standard rates of 1888, nor fall below 30 per cent. above that standard. Since the beginning of last year, wages have stood at the maximum, although in all other districts very substantial reductions have been made. The fall of 10 per cent. now to take place means that a man who in 1888 was earning 30s. per week, and who has for the past eighteen months been getting 48s. for the same amount of work, will now get 45s.—not a very serious reduction, and one which leaves him still in the enjoyment of substantially increased wages compared with former years. But, judging by the reception of the news at the annual demonstration of the Yorkshire miners at Rotherham last week, the miners are greatly dissatisfied at Lord James of Hereford's award; and, though there is no reason whatever to fear a strike against the present reduction, the spirit in which what should have been looked upon by the men as the inevitable has been received, shows that one cannot but look forward with apprehension to the time when it will be necessary for the owners to demand further reductions—until, in fact, the minimum is reached.

For there can be no doubt, in reasonable minds, that the price of coal will, for a long time to come, rule at a very low level, gradually getting lower than it is at present; and in order that they may be able to compete with other districts (in Scotland the owners are now claiming a reduction of wages to the minimum rates), the Federation owners will be obliged to cut the cost of production—that is to say, the

wages—down as low as possible. Then the trouble will come; and, although the miners' leaders are now indignant with the men for not accepting their recommendations, and thereby making them (the leaders) appear before the coal-owners as discredited representatives, these same leaders are in large measure responsible for the present temper of the men. At all these annual demonstrations, such as that at Rotherham, the big drum is always beaten, the coalowners are spoken of as rapacious and unjust capitalists, and the balance at the Union's bank, and the great power of the Union, are always called attention to with almost wearisome iteration; so that it is scarcely a matter for surprise that the men begin to fancy themselves really to be the masters. When the North Country miner is told that there is about four pounds a head at the bank, he wants to get "summat" for his money—which usually means squandering the lot, and losing much wages besides, in a useless attempt to withstand a well-justified reduction in the rates of pay. That is what we fear in the not-distant future. But, as George Eliot remarked, "prophecy is of all forms of error the most "gratuitous;" so we will be content with pointing out the possibility of trouble without prophesying as to its advent.

The Prices of Gas Oils.

An article appearing in another column on "The Price of "Gas Oils" will be found interesting reading by those gas managers who are in the market of this "volatile" commodity, and possibly likewise by such as are in the habit of thanking their stars that they have so far been able to do without it. We give the information for what it may be worth, premising that, while it came to us from a good source, we cannot justify every word of it. The cheapness or dearness of gas oil is a relative term, and cannot be properly appreciated until the figure is translated into the cost per 1000 cubic feet of gas of the illuminating power desired. We are not, be it said at once, reconciled to the conduct of the oil merchants in 1900 by the circumstance that oil is going begging at half the price to-day. The commodity seems to be altogether too mercurial, as regards price, to be pleasant. As we have said before, the world's yield of gas oil is in too few hands for it to be safely trusted as the raw material of a national manufacture. The recent particulars given in the "Journal" of the state of the Russian oil trade are in a sense reassuring as to the prospects of the continued cheapness of the article; but who knows what hands control the importation and marketing of it in this country? The acknowledged collapse of the much-puffed Borneo trade is a hard hit for the Shell Transport Company, and it remains to be seen whether or not the Texas supply will recoup them for the disappointment and the loss. It is difficult to know what to believe about oil, there are so many wheels within wheels in this trade. Obviously, those are lucky who can buy all the gas oil they need for years to come for £2 per ton; but they will be even luckier if they always get deliveries when they want them, especially if the value of the stuff should rise in the open market. 'Tis a far cry from Texas to the Thames or the Tyne.

The French Gas Society's Meeting.

Last week's gathering in Paris of the Société Technique de l'Industrie du Gaz en France, the proceedings of which are recorded in another part of our present issue, serves to call to mind the previous Paris meeting—the International Gas Congress of 1900. Now the Salle des Congrès is no more; but we are inclined to believe that the work it saw, the sentiments it heard, and the goodwill it fostered will long outlive even its memories. We are not sure that the meeting just held by our French colleagues cannot show some traces of its influence, evidenced by the wider outlook and the external character of some of the papers read. The address of the retiring President, M. Maurice Piaton, the head of one of the Lyons group of Gas Companies, and for twenty years past intimately connected with both gas and electric light undertakings, contained many effective figures, culled from his own extensive experience, comparing these rival illuminants. There was certainly no lack of technical material for one-and-a-half days' consumption; about thirty papers being presented, which almost represents one to every twenty members on the roll—surely strong evidence of the vitality, industry, and resource of French gas engineers, and their interest in their Association. Possibly, however, the quantity has over-watered the quality, for although several of the communications made will well repay examination, no particular technical key-note seems to have been struck, nor does any one paper stand conspicuously out in its merit, as did those of M. Verdier last year.

On a previous occasion, we called attention to the advantages arising from the free-and-easy summarizing of technical papers, instead of the hard-and-fast reading of them. This year, perhaps, the disadvantages of such an arrangement were more apparent, as more than once time was lost in discussing points fully explained in the printed text, but only partially mentioned in the verbal summary. What probably would most strike an English hearer at these French meetings, is the almost entire absence of discussion. There are, of course, questions occasionally asked, and these receive immediate replies from the reader of the paper; but sustained and formal argument, as known in our own technical gatherings, is, as far as our experience goes, of rare occurrence. Nevertheless, as we have already pointed out, the value of such meetings as the one just held in Paris is almost incalculable; and this value is not a mere personal one, nor a mere local one, but spreads into national, and even into international, profit. Experience and progress are concentrated and scattered widespread; ignorance and error are reproved and corrected; industry and ability are stimulated and awarded. It is for such reasons as these that we always welcome the annual proceedings of the French Gas Society, and record their doings with so much pleasure.

The Coal-Duty in Parliament.

The weary discussions in the House of Commons upon the Chancellor of the Exchequer's finance are over at last; and the duties on exported coal and imported cereals are voted for the year. There was not much information to be gleaned from all these largely perfunctory discussions, which were mostly the usual disputation between "Outs" and "Ins." Mr. J. Walton wanted to reduce the coal-tax from a shilling to a penny, which does not strike one as a statesmanlike proposal. The Chancellor of the Exchequer was cheered when he declared that there is no indirect tax which he should be so reluctant to interfere with at the present moment as the duty on coal. He had no difficulty in proving that the terrible results to British trade foretold by those who thought they were going to be hit by the duty have not been realized. The exportation of coal for the last five months was larger than ever. It is a little difficult for the mass of people to have patience with the wailings of coal-owners and colliers over a tax which is but a fraction of the amount of the ordinary variations of market prices. As for the coalowners, who had an extra 8s. per ton from the gas companies a couple of years ago "in the ordinary way of "business," the painful necessity of charging their foreign customers 1s. per ton more than the home price on account of demands by the National Exchequer cannot be believed to hurt them seriously. Of course, the pitmen think the tax has reduced their wages, and therefore they are opposed to it. Their judgment of such matters, directed as it is claimed to be by the leaders of the Federation, is not to be esteemed infallible. The only proposition that stands clearly out from the parliamentary debates on the Finance Bill, is that the usual contention of Labour politicians in favour of the exemption of the working classes from all the burden of taxation is untenable. If there is one irrefragable rule for the raising of the revenue required for running such an Empire as ours is to-day, it is that the feeling of the taxpayer should be implanted and cultivated in every free and independent member of the Commonwealth. Beside the creation of this sense of responsibility, the mere question of detail, as to what articles of consumption should or should not be taxed, sinks into insignificance. What has the claptrap about a "free breakfast-table" to do with the great question of bringing home to every adult person, not being a pauper, a constant reminder of his chargeability with the cost of Empire and the preservation of national liberty? Coal and corn are taxed with a view to this sensible rule; and if it were proposed next year to tax paper or ink, the only pertinent questions in the case would be the same as those which have been admitted by the Chancellor of the Exchequer as applicable to the revenue-raising expedients of the present year.

Legal Relations between Gas Suppliers and Consumers.

To-day we publish the last of a brief series of articles which has been compiled with the greatest care, in order to make clear what precisely are the rights enjoyed by, and

the duties imposed upon, gas supply undertakings in regard to the conduct of their business. Of course, case-law on different points is continually being strengthened or weakened, as fresh precedents are created; and it is therefore of the greatest importance that anything in the nature of a "legal guide" should be brought absolutely up to date. In the present instance, it has been attempted to accomplish this end; and it is hoped that the articles may be of assistance to readers in unravelling some at least of the knotty problems by which (as our postal correspondence only too clearly proves) gas and water officials are constantly assailed. In saying this, it must, of course, be clearly understood that it is impossible for any such treatise, be it never so exhaustive, to take the place of the legal adviser. With regard to particular questions of any importance, where there is even a semblance of a doubt, the principle of "Every Man his "own Lawyer" is apt to prove fully as disastrous as that of "Every Man his own Doctor." There are, however, many general points of law, as there are many simple ailments, which are capable of effective "home treatment;" and it is in dealing with these that the "JOURNAL" articles should be found specially helpful. Even when there is no room for doubt as to what are the strict legal rights in a certain set of circumstances, there is (as was remarked when commencing the series) often a very important question to decide—namely, whether it is good policy to insist upon the full measure of those rights. This is a point of view which should never be lost sight of, though it is greatly to be feared that statutory gas and water companies do not always regard their exceptional powers in a sufficiently generous light. If everybody were to insist upon his strict legal rights, the world would become a veritable "bear garden." A great deal more may often be gained by the judicious exercise of forbearance, than by a too strict interpretation of Acts of Parliament—which is popularly termed "high-handedness." The "JOURNAL" has always made a special feature of its law reports; and many cases fully reported in its pages which at the time of hearing did not appear to be of first-class importance, have subsequently proved of the greatest possible value as precedents. Indeed, some such cases when before the Courts were reported solely in our columns—for instance, that of the *Commercial Gas Company v. Scott*, referred to in this week's article. This case has, however, it may be remarked, since been copied into various law books. Then, again, there was the action of *Cresswell v. Gaslight and Coke Company*, which was fully reported in the "JOURNAL," though the judgment is not noticed in Michael and Will. Our pride in this matter may perhaps be pardoned, as it is certainly justified.

The Gas Manufacture Examination Pass List.

In view of the "Editorial Note" which appeared in our issue of the 10th inst., on the subject of "Technical "Education and Examinations," we desire to call special attention to the fact that, by the courtesy of the Superintendent of Technological Examinations of the City and Guilds of London Institute (Sir Philip Magnus), we are able this week to publish the "Gas Manufacture" examination pass list for the present year. This list is complete as it stands; but it does not give the names of the various prize winners. The information will, however, doubtless be forthcoming in due course; and we must exercise what patience we can in waiting to know who the lucky ones are. It may be remarked that the number of successful candidates on the present occasion shows a very gratifying increase; the passes in the two grades for the last three years being: 1902, honours 43, ordinary 109; 1901, honours 36, ordinary 79; and 1900, honours 33, ordinary 31.

Attacking the Naphthalene Problem at Plymouth.

The address delivered by the Mayor of Plymouth (Mr. J. A. Bellamy), in moving the adoption of the report of the Directors at the annual meeting on Thursday last of the Plymouth and Stonehouse Gas Company, of which he is Chairman, contained, as will be seen by the report given elsewhere, a reference to a matter of considerable importance to the managers of gas undertakings. The Company, in common with many others, are troubled with what has come to be known as the "naphthalene bugbear;" and the Directors have laid out a good deal of money in endeavouring to get rid of it. They have had experiments conducted at the works; and though an improvement has been effected, the evil has not been entirely remedied. Indeed, they began to think it was incurable. Last year, however, they determined to go thoroughly into the matter; and Mr. Bellamy announced with evident gratification that they believed they had now solved this troublesome problem. Their Engineer (Mr. P. S. Hoyte) has been conducting experiments with a small plant, and has succeeded, according to the statement of his Chairman, in "extracting the naphthalene at the "works." This being so, the Directors naturally conclude—reasoning doubtless on the principle embodied in the legal maxim, "*Sublatâ causâ, tollitur effectus*"—that if this constituent is taken out before the gas is sent into the pipes, it cannot afterwards be deposited therein. In consequence of the success of Mr. Hoyte's experiments, all attempts to prevent naphthalene obstructions by treating the gas after it has passed into the mains have been abandoned. Mr. Bellamy hopes and believes the new method will be an entire success. At the same time he is not too sanguine, as the plant is not quite complete. When it is, the Directors look forward with considerable confidence to getting rid of their enemy for ever; and, moreover, the Company will become distinguished by being the first in this country to adopt the system. If the hopes now entertained in regard to it are realized, joy will reign in the heart of many a troubled gas manager besides the one at Plymouth. For at least a quarter-of-a-century—ever since M. Brémond made known, through the medium of the "JOURNAL," the results of his investigations on naphthalene—this question has been more or less before us; and, as our readers are aware, it is now receiving attention from a Committee of the Southern District Association. If Mr. Hoyte, who is a member of that body, has been fortunate enough to find a method for removing an evil which has persisted for so long, notwithstanding the many attempts that have been made to abolish it, he will deserve the congratulations not only of his fellow-members, but of his colleagues in the gas profession; and he may be sure that they will be only too pleased to give expression to their sentiments whenever he finds himself in a position to enlighten them in regard to the process by which he achieved this happy result. Should it prove equally satisfactory on a working scale, the Directors of the Plymouth Gas Company will have rendered a distinct service to the gas industry by initiating the experiments which brought its value to light. We await with much interest further particulars in regard to them.

In Memory of Minckelers, the "Discoverer" of Coal Gas.

A movement is on foot to erect, by public subscription, a monument in honour of Professor Jean Peter Minckelers, in his native town of Maastricht, in the province of Limburg, Holland. He was appointed Professor of Natural Philosophy at the University of Louvain in Belgium in 1772, when he was 23 years old. In 1783, in the course of investigations aiming at the discovery of a cheaper gas than hydrogen for inflating balloons, he produced coal gas, and described it in a memoir, published at Louvain in 1784. He made it from coal in a gun-barrel, and observed that it was formed freely and quickly, and was inflammable. In 1785, he lighted his lecture-room at Louvain with coal gas, and apparently continued to use it there for years. Thus he anticipated both Lebon, the Frenchman, and William Murdoch, in the discovery of coal gas—if the generally accepted dates of their discoveries are correct. The monumental stone on Murdoch's old house at Redruth, in Cornwall, states that he invented gas there in 1792. In the "JOURNAL" for Jan. 7 last (*ante*., p. 25) further particulars of Minckeler's claims were given. A Committee, of which the Mayor of Maastricht is Chairman, and Heer P. Bolsius, the Manager of the gas-works at 'S Hertogenbosch (Bois le Duc), and Heer J. W. H. Bauduin, the Manager of the gas-works at Maastricht, are Secretaries, has been formed for the purpose of furthering the scheme for the erection of a Minckelers' monument at Maastricht. They ask, in a circular letter, which we believe has been widely distributed among English gas men, that contributions in support of the scheme may be sent to Heer P. Loomans, at Maastricht, who is the Treasurer, and a relative of Minckelers; and we may express the hope that there will be a hearty response to the appeal.

The Old Scapegoat.

It would perhaps be going too far to say that, as a seaside resort, the glory of Weymouth has departed, yet there

is something about the architecture and general appearance of the houses overlooking its beautiful bay which is strongly suggestive of a bygone time. Nevertheless, it has certain attractions and advantages; and therefore it is incumbent upon the Corporation to see that nothing is done to deter visitors from resorting to it for health or recreation. Consequently, when they began to find that the town was at times pervaded with most objectionable odours, they could scarcely do otherwise than institute an inquiry into their cause. As they had not a Medical Officer of Health, the services of Dr. Louis Parkes, who occupies this position in the borough of Chelsea, were requisitioned; and he visited Weymouth on the 15th and 17th ult. to investigate the cause of the trouble. He inquired as to the possibility of the smells complained of being due to the sewage works, the Backwater, or the brickfields; but he thought all these might be excluded from serious consideration. His conclusion was that the unpleasant odours emanated from the gas-works, and that they were due to the quenching of the coke resulting from the carbonization of sulphurous coal. It must be acknowledged that a smell resembling hot iron quenched with water with a flavour of rotten eggs about it (which is the singularly expressive description of it given by Dr. Parkes) is not one which would cause visitors to make for Weymouth, though it does not keep them away from Harrogate, where it assails the olfactory organs of all who venture into the neighbourhood of the renowned sulphur spring. Of course, one story is good till another is told, and the report must be taken as an *ex parte* statement. It is very singular that these smells should have prevailed ever since the establishment of the sewage-pumping station in close proximity to the gas-works; and it may be a question for future consideration how far this is responsible for the trouble which has arisen. As far as the Gas Company are concerned, their sole desire is to carry on their operations so as to cause the minimum of inconvenience to everybody; and before any steps are taken in the direction suggested by Dr. Parkes—application for an injunction in the event of a recurrence of the nuisance—the Corporation should make quite sure that they are not themselves the offenders.

WATER AFFAIRS.

Position of the London Water Question.

The Joint Committee on the London Water Bill made their report to both Houses of Parliament last Tuesday; and the Bill, as amended, stood third on the orders of the House of Commons for yesterday, with a page of amendments in reference to it. In accordance with the promise made by the Chairman, they presented a short report explanatory of the process by which the decision in regard to the third schedule was arrived at. It will be found in our "Parliamentary Intelligence," and may be left to speak for itself. After reducing at a stroke the number of members of the Water Board to about one-half, by the exclusion, unheard, of the Metropolitan Borough Councils, the Committee allowed the parties thus summarily treated to give evidence; and, as the result, decided by an equality of votes not to adhere to their resolution. Not only so, but they actually increased the original number of members by four; so that in the amended Bill the Water Board is composed of 71, exclusive of the Chairman and Vice-Chairman. The Bill left the Committee's hands in a more satisfactory condition, from the Water Companies' point of view, than it was at the outset, thanks to the exertions of their officials and the array of learned Counsel representing them. But it still contains several very objectionable features. The Companies, as the Chairman of the Chelsea Company told the shareholders last Thursday, would naturally have preferred that the arbitrations should be conducted under the Lands Clauses Act—that is to say, that an Arbitrator should be appointed by each side. But this procedure is denied them. The Board of Arbitration remains unchanged; but, from the status of its constituent members, there is no reason to doubt that it will deal justly and fairly by the Companies. The latter scored, however, in getting a postponement of the appointed day for twelve months certain, with a possibility of a further extension of time till June, 1905, before which date it may be supposed terms of purchase will be arranged. Judging by recent utterances, there seems to be a general satisfaction that, by the water supply being entrusted to a specially constituted body, the inhabitants of London will be spared the consequences which would have ensued if it had been handed over to the London County Council; while the Water Companies will not be likely to get very much better terms than those which are offered to them under the provisions of the Bill. Looking at the position all round, the London Water Question appears to be nearer settlement than it has been for some time; and there has surely been enough agitation over it to justify the hope that appearance may become reality before the end of the present session. If Londoners have a burning desire to control their water supply, they will probably soon be able to do so—at a price.

Conserving the Thames.

In the course of the proceedings in the Committee on the London Water Bill, Mr. Balfour Browne, K.C., speaking in support of a claim put forward for increased representation of the Thames Conservancy on the proposed Water Board, with the view of the interests of the up-river districts being safeguarded, defined in some detail the duties of the body over whom Sir F. Dixon-Hartland so ably presides. Put concisely, they are to "conserve" the river for the use of London generally, and the Water Companies in particular; and the Conservators keep a sharp eye upon all who are likely to interfere with its purity. For this, as he reminded the Committee, they are paid a large sum by the Companies. The extent of this payment and the work done by the Conservancy last year are to be found recorded in their annual report, which has lately been issued. In respect of the Upper Navigation, the Companies drawing from the river paid the Conservancy £24,447; and a sum of £3805 was expended upon the office and outdoor staffs and the Analyst who are directly connected with the purification of the river, including the proportion of the expenses of the Solicitor and of the ordinary staff attributable to this purpose. There was consequently a good balance to cover the general expenditure. In carrying on their operations, the Conservators endeavour to secure the purification of the waters of the river and its tributaries without bringing too heavy pressure to bear upon the authorities concerned. During last year, pollution from twenty-six towns and villages, representing a population of 60,000, was diverted from the streams. There are still, however, places in the watershed where the requirements of the Thames Act of 1894 have not been complied with, though in almost all these cases steps are being taken to place the drainage arrangements on a satisfactory basis. Unfortunately, the Conservators' powers do not enable them to prevent the passing of trade refuse into tributaries situated at a greater distance than three miles from the river. It certainly seems reasonable, in order to ensure greater purity, that they should extend over the entire watershed, without limitation. With regard to the flow of the river, this was fully maintained. Though the total for the year was below the average, the flow during the summer months was about 200 million gallons per day at Teddington Weir, due in great measure to the heavy rainfall in July.

Charge for Water Supply to Lock-up Shops.

Judgment has just been given at the Chester County Court in a test-case affecting a large number of tradesmen who rent lock-up premises for trade or business purposes. The action was brought by the Chester Water Company for the recovery of water-rate under section 43 of their Act of 1857, which entitled them to charge at a rate not exceeding 7 per cent. per annum on the annual value of premises for water supplied for domestic use. The defendant contended that, as the premises consisted of a lock-up shop used for trade or business purposes, the Company could only charge by meter or special agreement. It was admitted that defendant and other members of his family generally took their meals in the shop, and that the water was used for trade purposes and for cooking, &c. But as no one slept on the premises, it was argued that they were not a "dwelling-house." The Company only charged one rate for the water—that is, as a domestic supply. The Judge said the only point for him to decide was whether the supply was one for domestic use; and it seemed to him to be difficult, on the authorities or on principle, to contend that it was not. Therefore the shop fell within the category of a dwelling-house, as contemplated by the Act; and so he gave judgment for the Company. The matter may be heard of again, as leave was given to appeal, if it should be considered advisable to do so.

THE

INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTY-NINTH ANNUAL GENERAL MEETING,

HELD AT THE

ROYAL VICTORIA ROOMS, SOUTHAMPTON,

JUNE 10TH TO 12TH, 1902.

Mr. S. WESTALL DURKIN, President.

PAPERS READ.

LARGE GAS-ENGINES AND THE GASES USED BY THEM.

By DUGALD CLERK, M.Inst.C.E.

The large gas-engine has arrived at an interesting and critical stage of its development, at a time when the conditions of coal gas manufacture are also changing—when gas engineers are seeking new standards of the qualities required in coal gas. Baron von Welsbach's great invention of the incandescent light has supplied a new standard in one direction; and the growing importance of the gas-engine introduces new requirements in another direction. The welfare of the coal gas manufacturing industry requires the production of a gas which will satisfy alike the requirements of light, gas-power, and gas-heating.

Broadly, the incandescent gas-light requires, for the best economy, gas capable of yielding the maximum possible flame temperature. The cost of gas at present prices is sufficiently low, in view of the fact that the thorium-cerium mantle gives readily 25-candle power for every cubic foot consumed per hour in ordinary low-pressure burners; while as much as 40-candle power per cubic foot has been obtained in pressure lamps. The flame temperatures require to approximate closely to 1800° to 1900° C.

The gas-engine for economical use does not require such temperatures; and this has been proved in an interesting manner by indicator diagrams taken on large gas-engines. With coal gas the temptation has always been present to get as much power as possible out of any given gas-engine, by increasing the flame temperature. In the earlier compression gas-engines, flame temperatures of about 1800° C. were often used; and it has required the modern development of high compression to show that such temperatures were undesirable. It has now been proved in practice, as was already known in theory, that the heat efficiency of a compression gas-engine within wide limits does not fall with reduced flame temperature—that is, that an engine using a weak gas can convert as large a proportion of the heat into mechanical work as when a rich gas is used. The gas-engine, in fact, requires a gas which will cost as little as possible per heat unit evolved, and does not require a high flame temperature. At the same time, gas-engine constructors prefer a rich gas such as coal gas, because somewhat greater power can be obtained with a given engine, and the valve and governing arrangements of the engines are simpler.

In view of the improvements in gas producers now in progress, and the gas-power schemes initiated by Dr. Mond, it appears to the author of interest to gas manufacturers to study the recent advances in large gas-engines. Gas-engine makers and designers prefer coal gas for gas-engines; but if it cannot be obtained at a sufficiently cheap rate, then it becomes prohibitive for large engines, and producer gases in some form must be used.

Thus coal gas, although supplying an ideal system of distributing power, practically is not used for large gas-engines at all. When a gas-engine exceeds 50 indicated horse power a producer plant is generally adopted. If, in changing the gas supplied from high-candle power to low-candle power, gas engineers could sufficiently lower the price for power purposes, then a very large increase in gas-engine consumption would follow.

Large gas-engines may now be defined as gas-engines exceeding 100 indicated horse power. The limit has been gradually ascending; and it is difficult to say where it will stop—probably not until gas-engines are built as powerful as the largest steam-engines. So far, a greater number of large gas-engines have been built on the Continent than in England. The author, on recent visits to Germany and Belgium, inspected very powerful gas-engines built by four firms—viz., Messrs. Cockerill, of Seraing, the Deutz Gas-Motoren-Fabrik, of Cologne, the Deutsche Kraftgas-Gesellschaft, of Berlin, and Messrs. Körting Bros., of Hanover. The Cockerill and the Deutz engines both operated on the Otto or four cycle; the two latter makers, on the two cycle—Messrs. Körting's engine being a revival of the Clerk cycle, invented by the author in 1881, and the Berlin engines operating on a modification of that cycle. All these engines were operating with blast-furnace gases; some were used for actuating air-blowing cylinders for the furnace, and others for driving dynamos.

Taking the "Otto cycle" engines first, the largest engine examined was at the Hoerde Iron-Works, in Westphalia. This engine has four cylinders, each of 33 in. diameter and 39·3 in. stroke; diameter of crank shaft, 16·5 in.; and speed 135 revolutions per minute, at which it gives a maximum of 1200 brake horse power. Fig. 1 is a general view of this engine, and fig. 2 is a plan of a 500-horse power engine, having two cylinders of the same dimensions. The larger engine consists of two engines (such as in fig. 2) bolted to a common foundation, and acting on one shaft by means of two cranks. The four cylinders are thus arranged two and two, opposing each other; so that two pistons are worked from the one crank pin. In this engine, the large dynamo between the cylinders serves as a fly-wheel. This

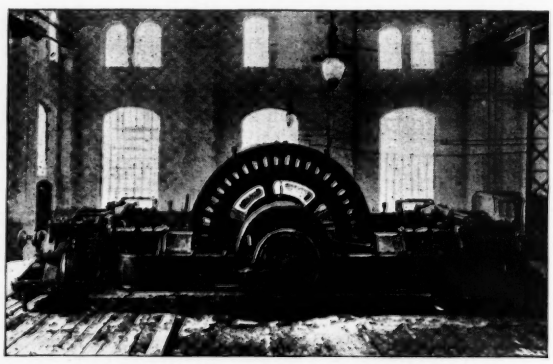


FIG. 1.—GENERAL VIEW OF 1200-HORSE POWER GAS-ENGINE AT HOERDE.

is clearly seen in fig. 3. The part sectional plan, fig. 2, shows the construction of the engine clearly. The cylinder liner A is pushed into the water jacket casing B from the back end, and secured at that end by means of the same studs which fasten the back cover C. The front end of the liner is not fastened to the casing, but passes through a stuffing gland D. This allows the liner to freely expand and contract, by difference of temperature between the liner and the casing. This is a most important point, which requires great attention in large gas-engine cylinders. In the absence of this precaution, so long a cylinder is very apt to crack or distort, or to crack the water-casing. The piston is provided at its front part (which takes the side pressure of the connecting rod) with white metal rings, cast into grooves, to reduce friction and reduce the wear upon the liner. The piston has, it will be observed, seven rings and oil grooves in front of and behind the outside set of five rings. Within the piston are cast ribs, which stiffen the piston end, and at the same time serve to conduct away heat from the end to the sides, where it can pass to the part in contact with the water jacket.

It is interesting to note that these engines have been at work at Hoerde for some years now, without water-jacketted pistons. During the author's recent inspection at Hoerde, the engines were stopped for the purpose, he was informed, of supplying them with water-cooled pistons. Two of the pistons which had been at work without water-cooling were examined by him, and found to be in very good condition. The piston ends, however, had obviously been very hot, judging from the red colour of the metal, and may have given rise to pre-ignition. It was interesting to find, however, that pistons so large as 33 inches diameter could be run without water cooling.

Referring again to fig. 2, it will be noted that the piston comes close up to the cylinder cover, and the compression space consists of a long flattened part E—seen in side elevation in fig. 4. The lower valve F opening into this port is the exhaust valve, and the upper valve G^1 is the charge inlet valve. Both are operated positively by levers from cams on the familiar side-shaft. The casing containing the inlet valve is divided into two portions. The upper portion admits gas, and the lower portion admits air; and the gas passes into the air by way of apertures in the dividing wall. The gas is admitted to the upper chamber by the positively operated gas-valve I; and during the suction stroke, the gas flows from the upper chamber, through the holes in the division wall, into the lower one, mixes with the air there flowing, and the mixture then passes through a perforated cone under the valve disc, and thence into the cylinder. By firing the gas and air through varied sections, a very perfect mixing is obtained. All the valve-heads are cooled with water.

As blast-furnace gas varies in composition, it is necessary to be able to vary the proportion of air to gas. For this purpose the throttle-valve K is provided, which is once for all adjusted to regulate the proportion of gas to air. The engine is started in the first instance by compressed air stored in a separate reservoir, by means of a small separate engine. This compressed air is admitted to the cylinder by the horizontal valve L, which is operated from the side shaft by a roller that is moved aside when the engine has been started. In these engines electric ignition is adopted, of the type in which a magneto machine armature is liberated and operated by a spring, where, at the point of maximum armature velocity, contacts within the cylinder are separated, and a dense spark is produced. M is the igniting port, with the contact

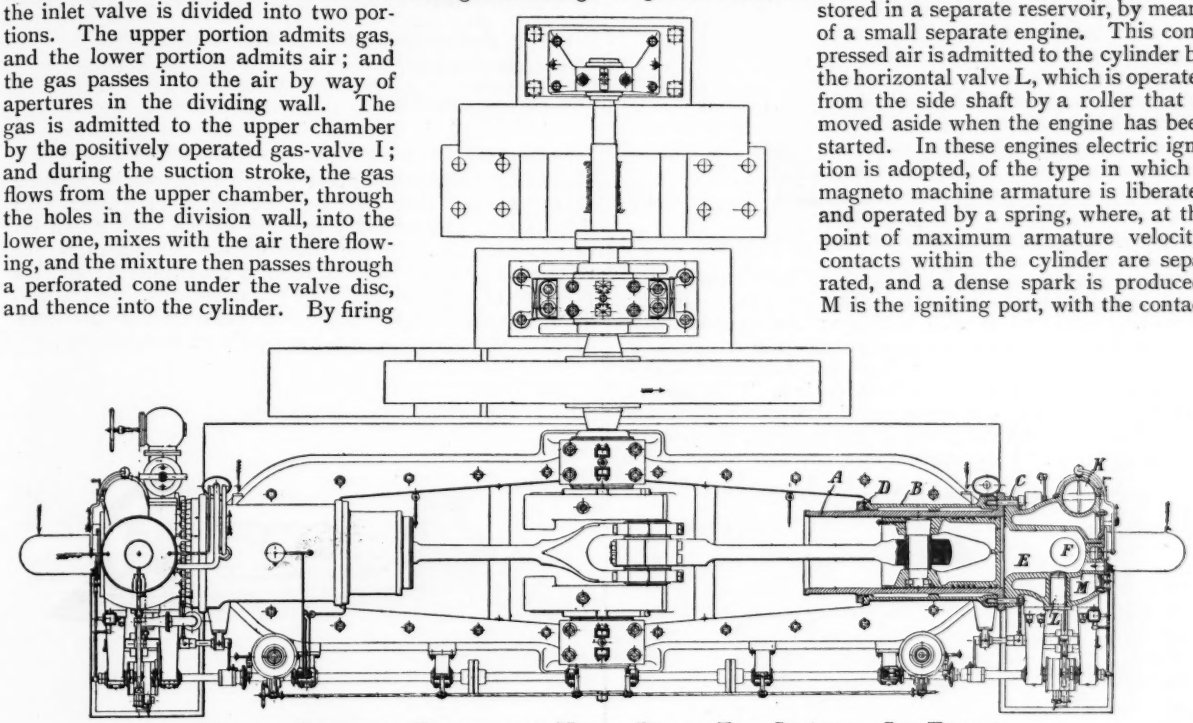


Fig. 2.—Sectional Plan of 500-Horse Power Two-Cylinder Gas-Engine.

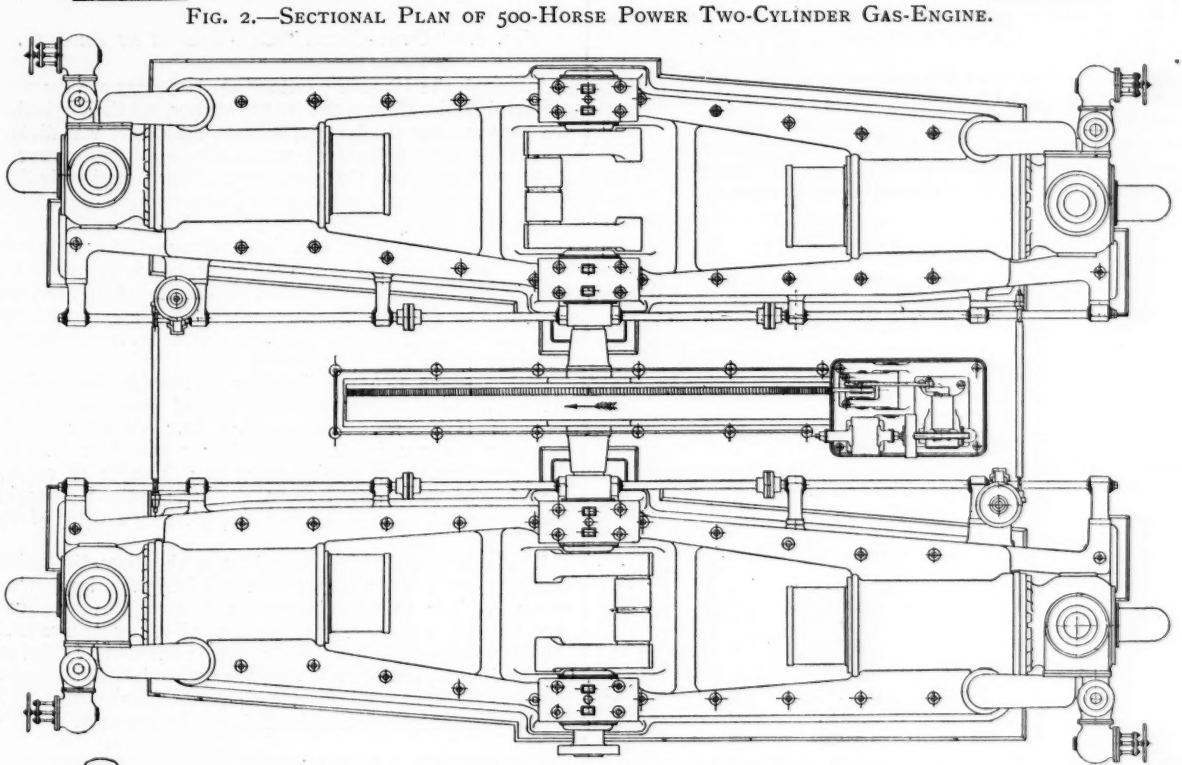


Fig. 3.—Plan of Gas-Engine (1000-Horse Power) at Hoerde.

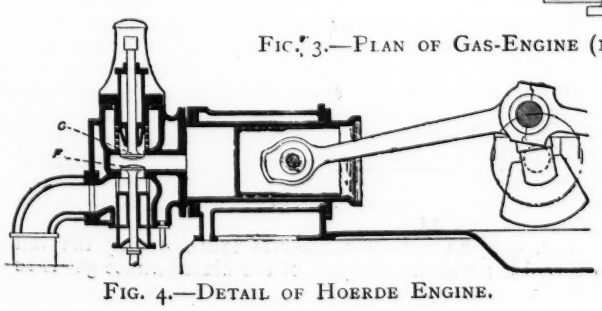


Fig. 4.—Detail of Hoerde Engine.

breaker for producing this spark. It was noticeable that all the large Continental gas-engines inspected by the author ignited electrically, and nearly all by magneto and low-tension spark. This is found best for weak gases, such as blast-furnace gas.

The governing is effected by varying the point of opening the gas-supply valve. The air admitted is thus practically (though not quite) constant in volume; but the proportions of gas and air admitted are practically constant. Less mixture is admitted, as the gas opens later. The long flat

port secures, however, that the charge next the electric spark is ignitable under all conditions of load. The engine, when governing thus, gives an impulse for every two revolutions in each cylinder—that is, in all, two impulses per revolution. In this engine, there is no scavenging by air; and at the first glance it seems diffcult to understand why the engine runs so steadily, practically without pre-ignition.

FIG. 5.—DEUTZ GAS-ENGINE DIAGRAM.

There are several causes for this. The first is that blast-furnace gas is so feebly inflammable that pre-ignitions are not so readidy produced as with coal gas; the second is that the long flat port which practically forms the compression space, exposes a large surface to water contact, and therefore allows its contents to be rapidly cooled. This feature, although it reduces the economy of the power explosion by cooling the flame, yet prevents pre-ignitions which would otherwise occur. This peculiar shape of the compression

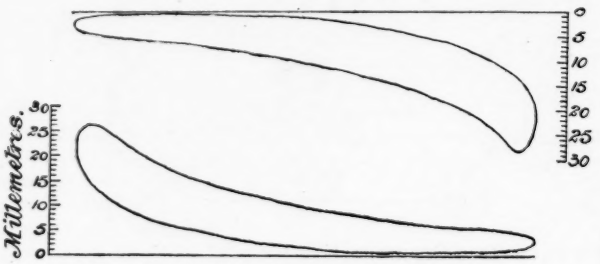


FIG. 6.—DEUTZ GAS-ENGINE DIAGRAM.

space is very bad from the point of view of economical gas consumption; but it no doubt supplies a good working compromise, which enables the engine to operate successfully without scavenging. It is better to have an engine which does not give the best possible theoretical diagram when it runs practically without danger of pre-ignition.

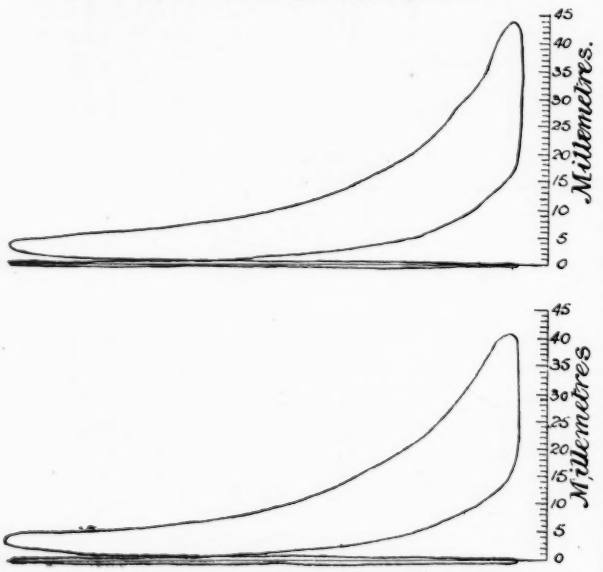


FIG. 7.—DEUTZ 1000-HORSE POWER GAS-ENGINE DIAGRAMS.

Fig. 5 is an indicator diagram from one of these engines, given by Herr Max Munzel, of the Deutz Gaz-Motoren-Fabrik, in the correspondence on the important paper by Mr. Herbert A. Humphreys, read at the Institution of Mechanical Engineers in January, 1901. Fig. 6 shows diagrams handed to the author at the Hoerde works by the engineer in charge of the engines. These diagrams were obtained at the lower speed of 120 revolutions per minute; and they show a considerable increase in mean pressure.

Fig. 7 shows diagrams taken from an engine of similar dimensions working with producer gas. These diagrams (kindly sent to the author by the Deutz Gas-Motoren-Fabrik) are interesting as showing the variations due to change of speed, and also change of gas.

The following is an analysis showing the chemical composition of the blast-furnace gas used at the Hoerde works:—

Analysis of Blast-Furnace Gases at Hoerde.

Carbonic oxide	32·0	per cent.	by volume.
Hydrogen	2·5	,,	,,
Carbonic anhydride	8·5	,,	,,
Nitrogen	57·0	,,	,,
	100·0	per cent.	by volume.

The inflammable constituent here is thus mainly carbonic oxide—a very slow burning gas, which is ignited with difficulty by any ordinary igniting device, such as an incandescent tube. In the blast-furnace gas diagrams, the pressure of compression is about 9 atmospheres; and the pressure of explosion, about 15 atmospheres. In the producer-gas diagrams the compression pressure is about 9 atmospheres, the explosion pressure nearly 22 atmospheres.

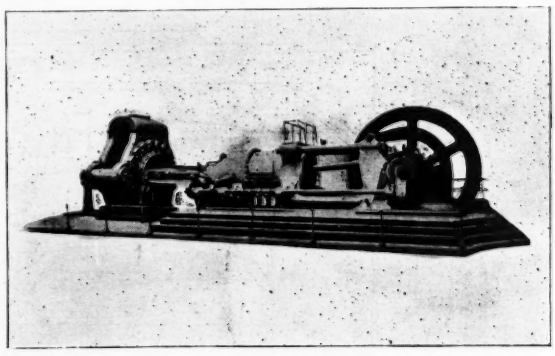


FIG. 8.—"OTTO-CYCLE" GAS-ENGINE AT SERAING.

Although the Hoerde "Otto cycle" engines are the most powerful engines inspected by the author, yet their cylinders are by no means the largest, because the power was divided up among four cylinders—practically 250-horse power to each cylinder. The Cockerill "Otto cycle" engines built at Seraing have much the largest cylinders of any gas-engines yet built. The engine examined by the author at work at Seraing is one which has been exhaustively tested by Professor Hubert and Dr. Aime Witz. It is the design of the late Mr. Delamare-Debouteville—an able Engineer, who devoted his life to the development of the large gas-engine, and, sad to say, died just as his difficulties were successfully overcome.

The large "Otto cycle" engine at Seraing has a single cylinder. The leading dimensions and particulars are as follows: Cylinder diameter, 51·2 in.; cylinder stroke, 55·3 in.; piston rod diameter, 9·6 in.; crank-shaft diameter, 18·1 in.; length of engine, 36·1 ft.; breadth of engine, 19·7 ft.; height above ground, 13·1 ft.; weight of engine and fly-wheel without blower, 124·9 tons; weight of fly-wheel, 32·5 tons.

These particulars give some idea of the huge dimensions of the engine; but a better idea will be given by a glance at fig. 8. The compression pressure is 135 lbs. per square inch; and the explosion pressure, 240 lbs. per square inch. The mean available pressure ranges from 60 to 65 lbs. per square inch. The normal speed is 90 revolutions a minute; and the maximum effective horse power (brake) 725. The mechanical efficiency of this engine is 81 per cent.

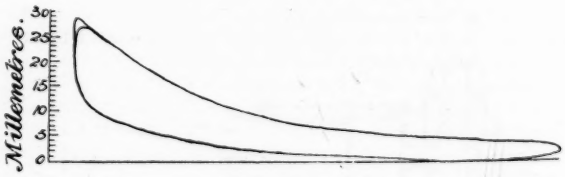


FIG. 9.

Fig. 9 is an indicator diagram taken during the test referred to; and the analysis of the blast-furnace gas is as follows.

Analysis of Blast-Furnace Gas at Seraing.

Carbonic oxide	27·90	per cent.	by volume.
Hydrogen	1·02	,,	,,
Marsh gas	7·00	,,	,,
Carbonic anhydride	13·95	,,	,,
Hydrogen	50·10	,,	,,

This gas, it will be observed, not only contains carbonic oxide, but it has a considerable volume of marsh gas, which accounts for the great difference in the appearance of the diagram fig. 9 from figs. 5 and 6. The ignition here is more rapid; and the heating value of the gas is higher than that of Hoerde. The engine differs considerably from the Deutz-Otto engines.

In the Cockerill engine, an open-ended cylinder is connected by four steel rods with main bearings carrying a strong crank-shaft. The connecting rod operates in a trunk piston

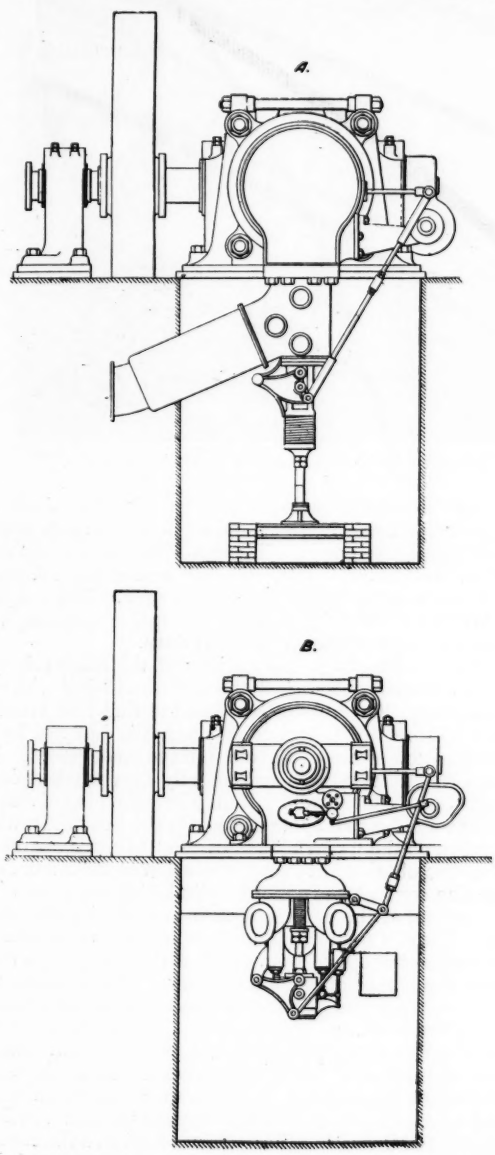


FIG. 10.—END ELEVATION OF THE COCKERILL GAS-ENGINE.

in the manner usual in gas-engines; but the piston is water-cooled at the end surface, and water is introduced through the end (in a continuous stream) by means of a system of jointed hollow links. The piston carries a hollow piston-rod, which passes through a stuffing-gland passing through the compression space of the engine. This stuffing-gland is packed with metallic packing. The piston-rod is continued, and operates crosshead slides which guide it, and connect it to the piston-rod of a blowing cylinder mounted behind the gas-engine cylinder. The valves are driven from the side shaft (see fig. 8); and they are of an interesting type.

Fig. 10, at A, is an end elevation, partly in section, showing the exhaust pipe and exhaust valve. The exhaust pipe, it will be observed, is water jacketted, in order to keep the pit underneath the engine cool. The exhaust-valve is operated by a link from a cam on the side shaft; and the link moves a tumbling lever, seen below. The exhaust-valve spring is placed outside the engine—well away from the heat; and the exhaust-valve spindle is surrounded by a water-jacketted casing. B (fig. 10) shows an end elevation further back than A; and here is seen the gas and air inlet-valve device, operated also from the valve-shaft by means of a cam. This figure also shows the electric ignition gear connected to a cam on the same shaft.

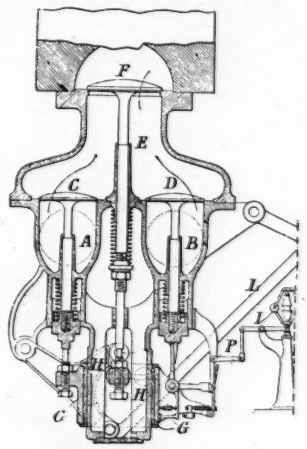


FIG. 11.—INLET AND GAS AND AIR VALVES OF THE COCKERILL GAS-ENGINE.

Fig. 11 shows in section (on a larger scale) the arrangement of inlet and gas and air valves. F is the inlet valve for the gas and air; C is the air-valve; and D is the gas-valve. The link L is constantly operated from the valve-shaft; and it moves a tumbling lever, which operates on a sliding cap G, which cap carries an adjustable screw, on the left-hand side, for regulating the lift of the air-valve C. On the right-hand side the gas-valve is operated by a hit-and-miss governing arrangement, which is controlled from a centrifugal governor I. The up-and-down movement of the sleeve G causes a projection from the lever L to either miss the end of the governor-operated arm P, or engage with it. If it misses, then the other end of the bell-crank lever L—that is, the end H—engages with the projection, and the valve D is lifted. If, however, the governor rises, and causes the lever L to engage with the end P of the governor lever, then L is depressed, and H moves out of the path of the projection D. In this way, the gas-valve remains closed. This large engine operates by the usual method of full explosion or no explosion. The governing is not very good; but it is sufficiently good for the purpose of an air-blower. The central valve F is opened by the same movement of the sleeve G; and the gas passing through the valve D, and the air passing by way of the valve C, mixes in the chamber E under F, and the mixture proceeds into the engine cylinder. The gas valve D is also operated from another source under circumstances to be explained.

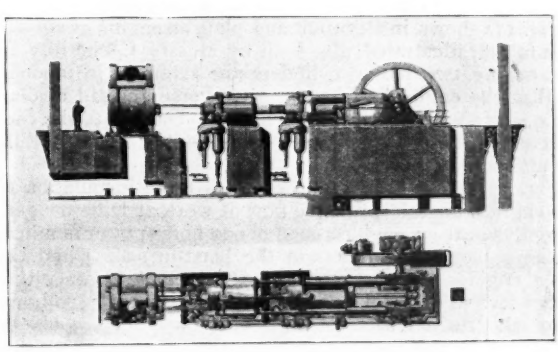


FIG. 11A.—COCKERILL ENGINE, TANDEM CYLINDERS, 1200-HORSE POWER.

In an engine using a water-cooled piston, it is absolutely imperative that the water shall always circulate while the engine is running. If the water stops, then the piston at once begins to heat up; and it quickly seizes in the cylinder. To prevent this, Messrs. Cockerill's engineers have

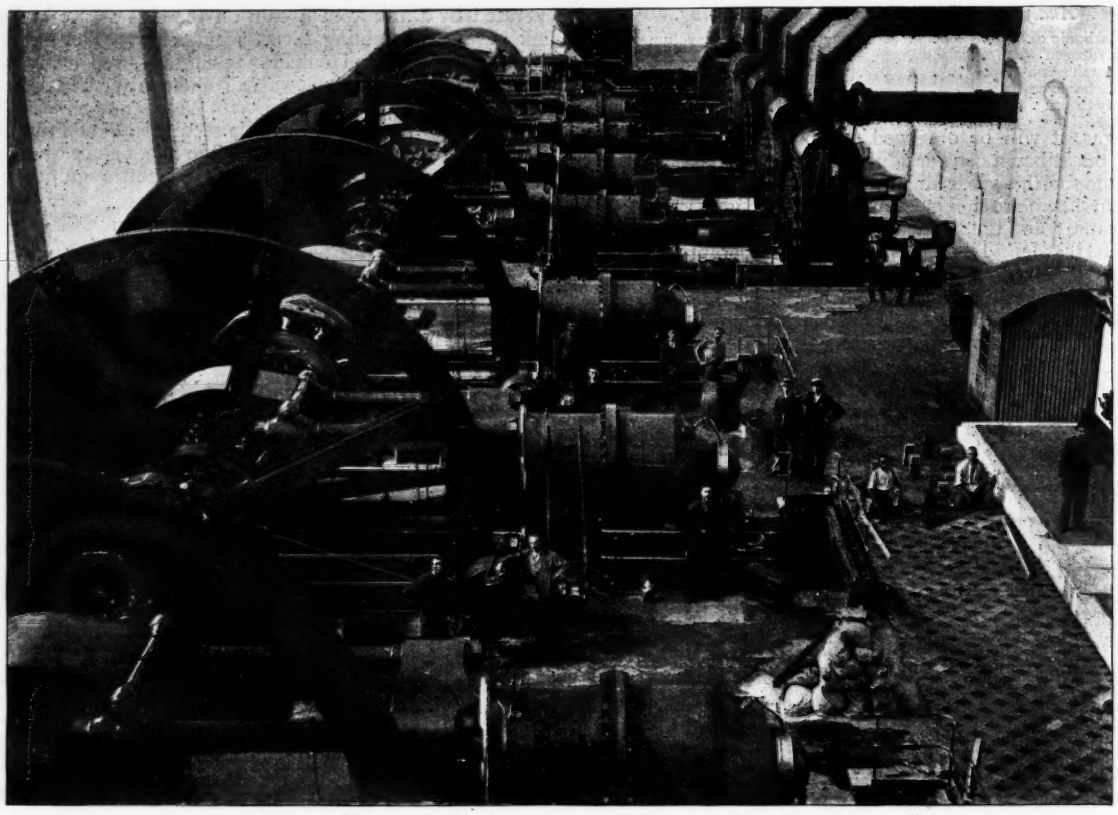


FIG. 12.—INSTALLATION OF NINE 600-HORSE POWER (NOMINAL) GAS-ENGINES AT DIFFERDENGEN.

applied an ingenious contrivance, by which the gas-valve D depends not only on the governor, but also on the water supply. The water, after passing through the piston, falls into a small open reservoir, which has a discharge aperture of regulated dimensions. When the water is flowing at a safe rate, the level in the vessel is just sufficient to keep at a constant point, discharging all that comes into it. A float then stands at a constant point; and so long as this float is up, the gas-valve is not interfered with. If from any cause however, the water supply be stopped, then the aperture discharges the contents of the vessel quickly, the float falls, and by a train of linkage it at once operates to prevent the gas-valve D being opened. The engine then stops.

In this engine both piston and piston rod are cooled by water. Consequently though no air-scavenging is used, the products of combustion in the compression space are rapidly cooled to a point which prevents pre-ignitions. Electric ignition is used in this engine; and the engine operates with great smoothness. The author stood beside it for a long time, and was very pleased to find it running with about three-quarters load without any trouble from back-ignitions or other causes. It was quite interesting to see so large an engine on the "Otto cycle" working so smoothly.

Fig. 11A shows, in elevation and plan, an engine of similar type to that illustrated, also built by Messrs. Cockerill. In this engine, two motor cylinders are arranged in tandem, so that the engine is rated at 1200-horse, instead of 600-horse. Here also a blowing cylinder is coupled to the end. Several of these engines were being built at Seraing while the author was there.

Fig. 12 shows a general view of a large installation of gas-engines on this principle now at work at Differdengen. Here there are six engines, each of 600-horse power nominal, working blowing cylinders at the blast-furnaces; and the three engines each of the same power, are generating electricity. The total power in this station is 5400-horse nominal. As a matter of fact, over 6000-horse could be developed by this installation.

A test of the large Cockerill engine just referred to, made by Professor Hubert, showed that the gas used at the lower thermal value, gave between 102 and 110 British thermal units per cubic foot. The mechanical efficiency of the engine was 81 per cent., and the heat balance sheet was as follows:—

Heat converted into work in the cylinder . . .	28 per cent.
Heat carried away by circulating water. . . .	52 "
Heat carried away by gases and losses . . .	20

The gas consumption, as a best result, was about 3·1 cubic metres per brake horse power; and 2·56 cubic metres per indicated horse power. These are the figures obtained by actual brake tests. The efficiency figures are calculated on the lower heating values of the gases used. These figures show Messrs. Cockerill's engines as capable of giving very large powers with economy and certainty.

The two leading large gas-engines of the four-cycle type have been described, and now the author will deal with two-cycle engines. The author is pleased to find that his early position with regard to two-cycle engines is justified by the present position of the two-cycle in large gas-engines. For large engines, the two-cycle undoubtedly has considerable advantages over the four-cycle. It may be remembered that the author invented a two-cycle engine, in the year 1881, which was known as the "Clerk" gas-engine. In this engine, an impulse was obtained at every revolution of the crank-shaft. The engine consisted of a motor cylinder having ports which were over-run at the outer end of the stroke by the motor piston. Parallel to this cylinder, there was arranged a displacer cylinder operated by a crank at right angles (or thereabouts), in advance of the main crank. This cylinder took in a charge of air and gas and air, and discharged it into the motor cylinder at the proper time. When the explosion took place, the motor piston moved forward; and when it crossed the exhaust ports, the exhaust gases discharged themselves to atmosphere, and then the gases (slightly compressed in the displacer cylinder) entered the motor cylinder at the rear end through a check-valve, displaced the contents of the motor cylinder through the exhaust ports, and filled the cylinder with gas and air mixture at atmospheric pressure. The displacer was arranged to discharge air into the motor cylinder before the gas and air; so as to prevent pre-ignition, and scavenge out the exhaust products. This engine was made in considerable numbers under the author's supervision, and also by certain other makers in this country, in America, and on the Continent. For small powers, the "Otto" cycle engine had undoubted advantages over the "Clerk" cycle; and, accordingly, after a time, the "Clerk" type of engine disappeared. For large engines, however, the two-cycle engine is making considerable headway. Two makers on the Continent now construct two-cycle engines. Messrs. Körting, of Hanover, build an engine which has the exact operation described above, but it is arranged double-acting, instead of single-acting.

Fig. 13 shows a sectional plan of a 500-horse two-cycle

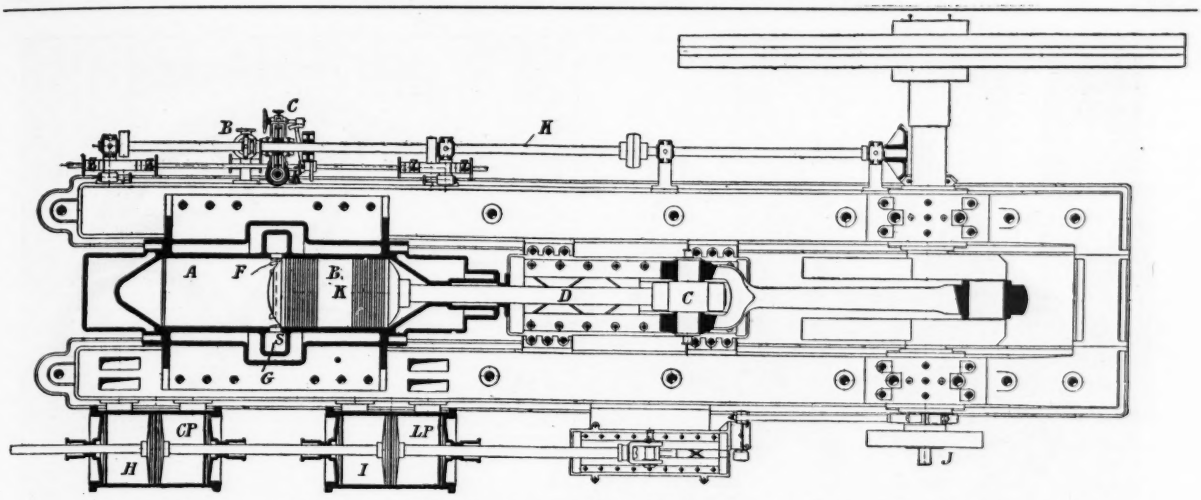


FIG. 13.—KORTING 500-HORSE POWER TWO-CYCLE DOUBLE-ACTING GAS-ENGINE.

double-acting engine, as made by this eminent firm. The engine is most interesting, both because of its smooth running and great power for relatively small dimensions. Fig. 13A is a longitudinal vertical section through the engine cylinder, showing an indicator diagram to illustrate the action of the gases in the cylinder. Fig. 13B is a transverse section through the admission valve and compression space and pump cylinder. Fig. 14 shows this 500-horse engine in general view.

The engine has one motor cylinder 24·8 in. diameter, and 43·3 in. stroke; the crank shaft has a diameter of 12 in., and two displacer cylinders each of 25·5 in. diameter and 33·5 in. stroke. The motor cylinder A is double-acting; and it carries within it a long hollow piston B, which is connected to a cross-head C by a hollow piston rod D. The cross-head is operated from the crank E, by a connecting rod, in the usual manner. The piston-rod passes through a water-cooled packing gland containing metallic packing. At the middle of the cylinder are situated the exhaust ports F, which open into an annular chamber G. The exhaust pipe connects up to this annular chamber, and the exhaust discharges to the atmosphere. Water is pumped through

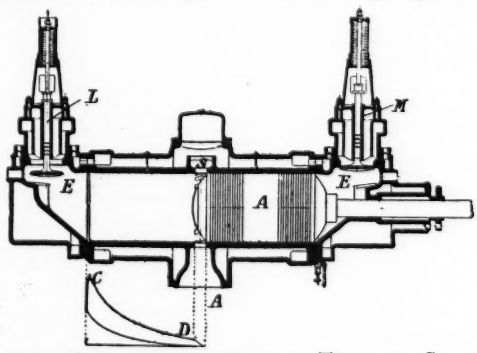


FIG. 13A.—LONGITUDINAL SECTION THROUGH CYLINDER.

the hollow piston-rod into the hollow piston and out again; the water connections being made by means of hinged pipes. H and I are respectively the air and gas displacer cylinders. Their pistons are arranged on one rod, and operated from the small crank J which is set at about 110°.in advance of the motor crank. K is a valve-shaft carrying cams which operate the charge inlet valves L and M (fig. 13A).

The action of the engine is as follows: Suppose the motor piston to be at the dead-point, as shown in fig. 13, on the right-hand end of the cylinder. The exhaust ports are then opened on the left-hand side of the cylinder. As the exhaust ports open, the pressure in the cylinder falls rapidly to atmosphere; and, before the piston has proceeded to the end of the stroke, the pressure touches atmosphere. At this point, the valve L is opened by its cam on the valve-shaft; and communication is made by means of the valves (see fig. 13B) with the ports shown. One of these ports first discharges air from the air-displacer cylinder, and the other port then discharges gas into the valve-chamber just above the valve L. A mixture of gas and air thus flows into the motor cylinder, and displaces the contents of the cylinder through the exhaust ports. It is to be noted that, because of the arrangement of the valve gear, air only enters the motor cylinder first in order to prevent contact between the inflowing inflammable mixture and the hot exhaust gases being discharged. The mixture of gas and air is produced just at the inlet valve; so that no mixture is stored in any reservoir. The cylinder is thus charged with a mixture of gas and air. The piston then returns and closes the exhaust ports. The admission valve also closes; and the inflammable mixture in the cylinder is compressed, in the usual manner, and ignited at the dead-point of the stroke. At the next advance of the piston, the ignited charge produces a

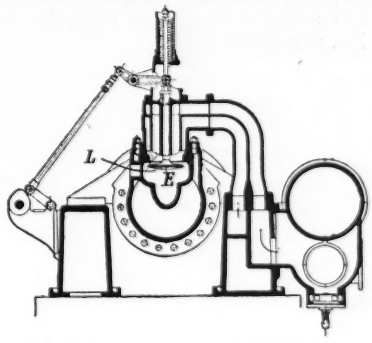


FIG. 13B.—TRANSVERSE SECTION THROUGH ADMISSION VALVE AND PUMP CYLINDER.

power stroke. A similar power stroke is produced both in front and behind the piston.

The action is thus exactly the same as that of a steam-engine. In order to obtain a charge of air in the cylinder, before the gas and air begin to enter, the gas-pump is so arranged that no compression occurs in the gas-pump until the gas-piston has passed the middle of its stroke. The gas, instead of being compressed into the passages, is passed to the other side of the piston.

In this engine, governing is effected while giving two impulses at each revolution. The governor acts upon the gas cylinder in such a way as to make the point of gas discharge later and later. Consequently a smaller and smaller inflammable charge is sent into the cylinder; but the charge is always retained near the inlet valve. Ignition is effected by a magneto igniter and separated contacts. The separated contacts are placed to act just under the inlet charge valve. In this way, a smaller and smaller impulse is obtained as required by the engine governing.

Two igniters are applied to each end of the engine cylinder. This has been found, by experiment, to be desirable, in large gas-engine cylinders where the volume of gas to be ignited is very considerable. For this purpose, four separate magneto igniters are employed. These four igniters are driven by a special shaft which is operated by cog-wheels driven from the main valve-shaft; but the part driving the igniters is connected to the driven gear by a screw or nut-like contrivance, so arranged that the angle between the driving and driven shaft can be varied. The object of this is to either advance or retard the ignition. When the engine is being started, the ignition is retarded; when the engine is at full speed, it is advanced. This

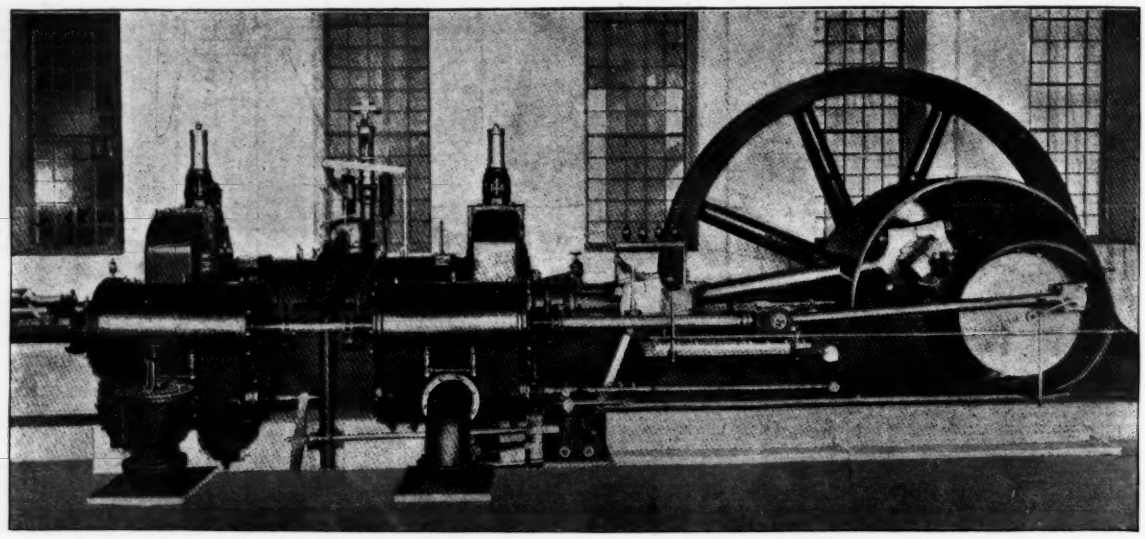
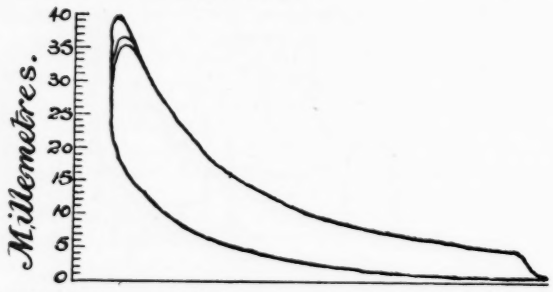


FIG. 14.—KORTING 500-HORSE POWER GAS-ENGINE.

arrangement permits of variation in the time of ignition to suit the nature of the gas to be used.

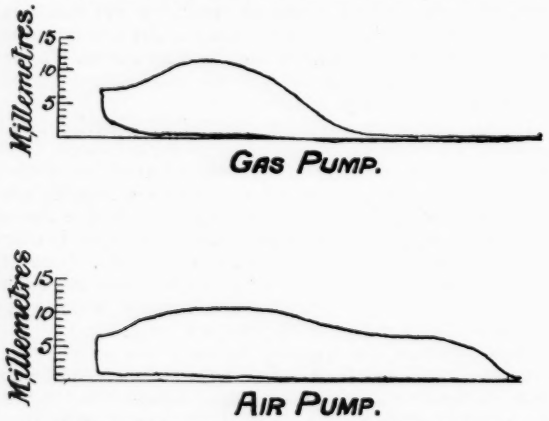
The author had the pleasure of inspecting recently a 500-horse power engine of this type in work at the Niederrheinische Hutte, Duisburg. It worked most beautifully; all the operations were conducted with smoothness quite equal to the steam-engine. The engine ran at 100 revolutions per minute; compression was between 10 and 12 atmospheres; and the maximum explosion pressure was some 300 lbs. per square inch.



Main Cylinder: Diameter 24 ft. 8 in.; stroke, 43 ft. 3 in.

FIG. 15.

Fig. 15 shows a diagram taken from this engine, for which the author is indebted to Herr Ernest Körting. Fig. 16 shows the air and gas pump diagrams on a larger scale.

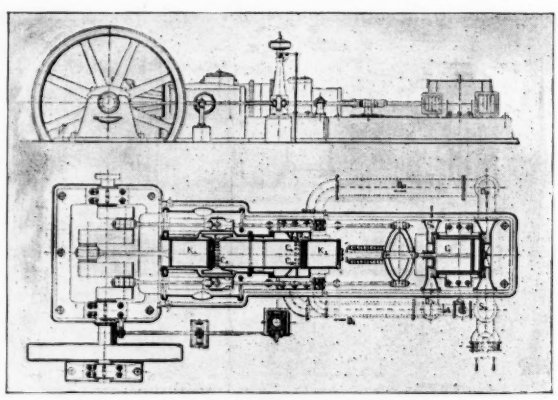


Cylinders: Diameter 25 ft. 5in.; stroke, 33 ft. 5 in.

FIG. 16.

Messrs. Körting inform the author that this engine gives an indicated efficiency of nearly 35 per cent. It consumed about 3·5 cubic metres of blast-furnace gas per brake horse power. The engine is started (as these large engines usually are) by means of compressed air. The engine inspected by the author was driving a blowing cylinder; and Messrs. Körting informed him that, with the blowing cylinder, the engine starts easily with air compressed to 10 atmospheres. Messrs. Körting have in hand engines of 700 and 1000 horse power of this type; and the author anticipates that the engine will become one of the most popular of the large gas-engines. It possesses many advantages over four-cycle engines. It is being taken up by prominent engineers in this country, and is being built also by well-known engineers in America. The Körting double-acting two-cycle gas-engine has just been introduced in Germany; and the first engines sent out are actually at work.

One other two-cycle engine of importance has also been produced in Germany; and a large number of engines of this construction are now at work. This two-cycle engine is the "Oechelhaeuser" motor. The author inspected several "Oechelhaeuser" motors at work at Hoerde, in the same



FIGS. 17 AND 18.—OECHELHAEUSER GAS-ENGINE.

engine-room as the large "Otto" engine. Two of these were twin cylinder motors of 600-horse power nominal, and one was a single cylinder motor of 500-horse power.

Fig. 17 shows in plan, a single cylinder "Oechelhaeuser" motor of 500-horse power nominal. Fig. 18 shows a side elevation of the same engine.* The engine is coupled to an air-blowing cylinder at the end.

In the "Oechelhaeuser" two-cycle motor there are two working pistons, which move oppositely in one working cylinder open at both ends. These pistons directly control both the discharge of the exhaust gases and the admission of the air and gas and air to form the explosive mixture to be compressed. When the pistons have travelled full in, or nearly full in, and the mixture of gas and air is compressed between them, it is ignited by an electric spark and the working stroke takes place. The pistons are driven apart by the working stroke. It will be observed that the

* Figs. 17 and 18 are reproductions, on a small scale, of the illustrations accompanying the detailed account of the "Oechelhaeuser" gas-engine which appeared in the "JOURNAL" for Nov. 12, 1901, p. 1232.

main crank-shaft has three cranks. The centre crank operates the front piston by means of a connecting rod; the two side cranks operate cross-head slides which are placed at the sides of the main cylinder; while rods from these slides operate a large cross-head behind the engine, and from this cross-head is operated the back piston and also the blowing piston. The air and gas pump is placed in a pit underneath the main engine; and it is operated by means of a rocking lever connected to one end of the back cross-head.

The action of the engine is as follows: When the back piston moves, it operates the large lever, and drives the charging pump. On one side of this piston, fresh air is sucked through suitable valves and discharged to a chamber. On the other side, gas is sucked and discharged into another chamber. The gas and air are separately stored in their separate chambers and pipes, at a pressure of about 0·3 to 0·4 atmosphere. When the motor pistons move apart under the influence of the explosion, one piston overruns the exhaust ports, and discharges the contents of the cylinder into the atmosphere. When the pressure has reached atmosphere, the other piston overruns, first the air ports, and air is discharged into the cylinder. This displaces some of the exhaust gases. The further movement of the same piston uncovers the gas ports, and gas is then discharged into the cylinder beside the air. It mixes with the ingoing air, and forms an inflammable mixture within the cylinder. By this device no mixture is made in separate chambers —explosive mixture is only made within the cylinder. As

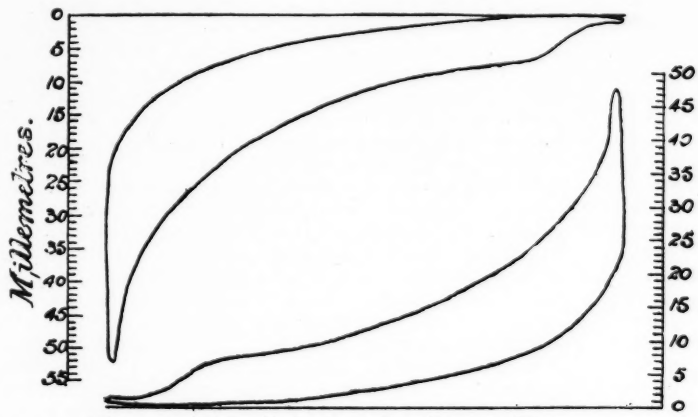


FIG. 19.—OECHELHAEUSER GAS-ENGINE DIAGRAM.

the engine rotates, the pistons cover the respective ports, and the charge is compressed.

In order to facilitate the escape of unburned gases through the exhaust ports, the dimensions of the working cylinder are so proportioned that the greatest quantity of gas and air discharged into the cylinder corresponds to only about 70 per cent. of the cylinder capacity. In this way, no loss is incurred at the exhaust ports. Electric ignition is used. In the engine inspected by the author two magneto igniters were operated simultaneously, and acted on sparking-points placed at opposite sides of the cylinder. By this device, ignition is made certain and sufficiently rapid. Governing is effected, as in the "Körting" gas-engine, by reducing the charge—that is, admitting a smaller volume of inflammable mixture of suitable strength for ignition. The "Oechelhaeuser" engines inspected by the author worked with great smoothness, and appeared to be very certain in all its valve operations.

It will be observed that, so far as the cylinder is concerned, the valve operations are of the simplest possible kind. One of the greatest difficulties which gas-engine builders have to face in dealing with blast-furnace gases is the difficulty of getting gas quite free from dust. The "Oechelhaeuser" engine has been specially designed with a view to meet this difficulty; and no doubt the smooth plain cylinder—smooth from end to end, without ports or irregularities of any kind—admirably aids in preventing the accumulation and facilitates the discharge of any dust which may find its way into the engine cylinder. All sensitive valve organs are removed from the cylinder. Although three cranks are employed, yet the system of operation of the engine allows the two pistons to be accurately balanced one against the other. Very little strain ever reaches the engine-bed, which is thus relatively a light one.

The author was very favourably impressed by what he saw of this engine. The makers construct engines up t 1000-horse power with one cylinder and 2000-horse power with two cylinders. At present the sizes made by them are: One-cylinder motors 250, 300, 400, 500, 750, and 1000 horse power; twin-cylinder motors, 500, 600, 800, 1000, 1500, and 2000 horse power. The "Oechelhaeuser" motor is a most interesting one.

Fig. 19 is an indicator diagram taken from one of the earlier engines working at Hoerde. This engine, the author should say, is a two-cylinder engine of 600 nominal horse power, claimed by Herr Oechelhaeuser to be the first large gas-engine driven with blast-furnace gas. This engine was set to work at Hoerde in January, 1899, and has operated continuously ever since. This is, perhaps, the longest run of any of the large gas-engines.

The author has now given a brief account of the construction and operation of the principal large gas-engines working on the Continent; and he would have been pleased to describe fully what is being done in this country also with regard to large gas-engines. In an important paper read by Mr. Humphrey at the Institution of Mechanical Engineers last year,* a full description was given of the results obtained by a Crossley 400-horse power "Otto cycle" engine, with tandem cylinders opposing each other, and of a Premier gas-engine of 500-horse power with tandem cylinders, one behind the other. English makers have been hard at work designing larger gas-engines; and firms new to the gas-engine have taken up for English manufacture both the Cockerill engine and the Körting engine. English makers, however, have proceeded somewhat more cautiously than Continental makers in the direction of increasing the size of their cylinders. Blast-furnace gas has hardly at all been used in this country for the purpose of driving gas-engines. One Crossley engine, the author is informed, is in operation at the works of Sir Alfred Hickman in Wolverhampton, and another engine of the Cockerill type at the works of Messrs. Cochrane, at Middlesbrough. So far as the author is aware, no other blast-furnace gas-engines are at work in this country. It is difficult to say quite why Continental engineers have succeeded in getting a considerable number of large gas-engines at work in iron-works, with blast-furnace gases. The author presumes the reason will be found in the greater expense incurred for fuel on the Continent, as compared with our own country. Nevertheless, it is important to remember the great source of energy to be obtained from blast-furnace gases. According to Mr. Booth, from 10 to 12 million tons of fuel are burned annually in English and Scotch blast furnaces; and the blast-furnace gases evolved in this country are sufficient to produce in gas-engines no less than 2½ million horse power over and above the power required for operating the blast-furnace itself. English engineers will doubtless speedily be able to utilize this enormous source of cheap power, for electric lighting and for power distribution purposes.

As Mr. Humphrey has dealt fully with the Crossley and the Premier engines, the author will not further describe them, but will only say that, in addition to Messrs. Crossley and the Premier Company, Messrs. Andrew & Co., Messrs. Tangye, and the National Gas-Engine Company are all engaged in designing large gas-engines. The author himself has also designed a large gas-engine operating on the Clerk cycle, which will shortly be built. English engineers are quite alive to the necessity of development for the large gas-engine; and they are attending to the matter in what he considers to be an earnest manner, and at not too late a stage of progress.

In this country, the gases available for large gas-engines at present appear to be mainly gases prepared from producers of the Dowson and other similar types. Practically Dowson or like gas is the only gas at present available in Britain for really large gas-engines. Blast-furnace gas, at any rate, has not been used to any extent here. The Continental engineers have encountered many difficulties in applying blast-furnace gas; the principal difficulty being, as has been said, the presence of dust. Very considerable scrubbing is required to get rid of the light, powdery dust evolved from some blast furnaces. The invention of the centrifugal

* See "JOURNAL" for Oct. 22, 1901, p. 1030.

scrubber used at Seraing and Hoerde, however, appears to have solved this difficulty finally. The centrifugal scrubber, with but small expenditure of power, purifies blast-furnace gas very effectively.

In addition to Dowson and like gases for power purposes, we are promised cheap gas by the Mond Companies. Their development will be watched with great interest. In the author's opinion, however, even at 2d. per 1000 cubic feet delivered in the works, Mond gas is not sufficiently cheap, as compared with Dowson gas, to give it much, if any, commercial pull; and it seems extremely doubtful to the author whether the Mond Gas Companies can really deliver Mond gas to pay at that price.

Efforts are being made by several engineers to dispense with the cumbrous gasholder common up to now with all producer plants. Messrs. Crossley, among others, are putting upon the market a gas-producing plant which operates with non-caking bituminous fuel, and supplies a gas-engine with clean gas without requiring any gasholder—further, producing the gas from fuel costing as little as from 9s. to 11s. per ton. Such an arrangement, when firmly established, will enable the gas-engine to provide power at less than half the cost of steam power produced by the very cheapest fuel. In a certain sense, all gas producers operating on a small scale compete with the gas sold by manufacturers of coal gas. Their fields, however, in reality do not overlap. If coal gas can be distributed in a large town at a price, heat-unit for heat-unit, of even 50 per cent. above that of Dowson producer gas, the gas consumption by gas-engines would enormously increase. Dowson producer gas on an average evolves about 150 heat British thermal units per cubic foot, whereas coal gas gives about 600 thermal units. Dowson gas at 2d. per 1000 cubic feet is thus equivalent to a price of 8d. per 1000 cubic feet for coal gas.

If, however, a cheap coal gas could be produced and distributed at 600 thermal units per cubic foot for about 1s. per 1000 cubic feet, then, in the author's view, there would be a very large demand indeed, both for power and heating. Is it not possible to produce a cheap gas for town purposes, capable of incandescing Welsbach mantles, supplying gas-engines, and gas cooking and heating apparatus? The Welsbach mantle removes the difficulty of high intrinsic illuminating power for lighting. A gas giving only 10 or 12 candles per cubic foot, when burned in the old way, would still give the maximum temperature required for successful incandescent gas lighting; and such a gas would be eminently suited for gas-engine purposes. Say that cheap coal could be used for producing the gas, and if water gas were mixed with it, no enriching oils would be required, it is surely worth the consideration of gas engineers to see whether a town supply could be given on such a scale.

From the present returns of the expense of gas manufacture, I notice that, even with expensive coal and oil enriching, gas is put into the holder costing little over 1s. per 1000 cubic feet. If very much larger quantities of poorer gas were supplied, would it not be possible to meet the wants alike of lighting, heating, and power, on a much larger scale than is contemplated now? Coal gas of about 600 thermal units supplied at anything like 1s. per 1000 cubic feet would cause an enormous expansion in the gas-engine industry. Gas-engines up to about 100-horse power would then commonly use coal gas.

Discussion.

Mr. J. M'Gilchrist (Dumbarton) asked what was included in the 2d. per 1000 cubic feet as the cost of Dowson gas. Did it comprise capital charges and interest, depreciation, and the expense of selling it—an item which was always charged against coal gas?

Mr. T. O. Paterson (Birkenhead) remarked that the members were much indebted for this paper to Mr. Clerk, who was one of the greatest experts in gas-engines. He had given some valuable information in regard to large engines using producer gas; but he (Mr. Paterson) should have liked to hear something more about the results obtained with the gas with which they were more concerned—for instance, the lower-grade gas used for illumination, and also blue water gas. He thought there was a large field for this, which was practically untouched at present; and if Mr. Clerk could tell them how far they might expect to go with success, they would be much indebted to him. He had intimated that ordinary coal gas was out of the question for very large gas-engines; but he (Mr. Paterson) did not quite see why, except that they required to have such large cylinders. But surely the largest engine could be used successfully with water gas.

Mr. J. West (Manchester) asked whether Mr. Clerk could state the volume of Mond gas or producer gas which would be required to secure the same effect as the 20-candle coal gas supplied in Manchester. He remembered many years ago making experiments with Dowson gas, which then cost a comparatively low figure—about 5d. or 6d. per 1000 cubic feet; and it was feared it would entirely supplant ordinary coal gas. He found, however, that it required about five volumes of Dowson gas to equal one of Manchester gas, when used in a Crossley gas-engine. He must say that this important subject had been dealt with in a most masterly manner by the author. He (Mr. West) had recently spent some time in America, where he found gas-engines were coming largely into use. He saw one of 650-horse power just about completed at the Westinghouse Company's place at Pittsburgh; and several others of large size, which were being erected at some new works being built in the neighbourhood. They were of the Westinghouse and Nash type, mostly three-cylinder engines; and they appeared to be supplanting steam-engines. In fact, in all new works they were putting up these large gas-engines for working dynamos, and manipulating the tools by electric motors; and most of the large machines now being put up in America were worked by single electric motors. It appeared to him that gas engineers could supply a gas which, if not found economical for very large engines, would at any rate be suitable for a great number of engines required for ordinary purposes. But if Mr. Clerk could suggest a producer gas which could be used for both lighting and power, it would be a great advantage to the community. No doubt electric motors could be worked very economically; and for a long time he had been an advocate of electricity as a motive power, especially for small motors. In America, however, he found it was being employed for very large machines. He did not believe in electricity as a lighting agent. It was for gas engineers to make a cheap gas, so as to supply a present much-felt want, in view of the fact that they had incandescent burners for lighting. The one idea of gas engineers should, he thought, be to reduce the illuminating power of their gas, and supply it in large quantity at a much cheaper rate. In America, they used natural gas extensively for this purpose; it being supplied at 4½d. or 5d. per 1000 cubic feet, and having great thermal power. The calorific value of ordinary gas had been given as 600 thermal units. But the natural gas, though its illuminating power was only 8 candles, would yield about 1000 thermal units; and it was therefore very valuable for gas-engines. If they could produce a gas of 10 or 11 candles, getting a large volume of it from the coal, they could heat up incandescent mantles sufficiently to produce a high illuminating effect, and at the same time would be able to sell it cheaply for heating and power purposes.

Mr. Isaac Carr (Widnes), after thanking Mr. Clerk for his excellent paper, expressed regret that no comparison had been drawn between the relative efficiency of a gas-engine when working with coal gas and with producer gas. As a gas engineer, he said he always endeavoured to put forward every advantage that coal gas possessed over producer gas; and one very important point was as to its efficiency. For instance, an engine which would give 100-horse power when worked with coal gas, would only give 75 or 80 horse power if producer gas were used. To put the same point in another form, an engine to develop a certain amount of power could be supplied at about 20 per cent. less cost if it was to be worked with coal gas than if producer gas was to be used. In the latter case, a larger engine would be required. With reference to Mond gas, with which he had some connection at the time the Bill was in Parliament, he was much interested in its calorific value; but this was not brought out before the House of Commons Committee. In fact, nobody knew what its actual power was. It transpired later, before the Lords Committee, that the minimum power of the gas would be 125 units. This afforded a basis for calculation as to the relative value of Mond and coal gas, which had been variously stated as 4 or 5 to 1. The calorific value of Dowson gas was 150 thermal units, which was practically about 5 to 1 in volume of coal gas; and taking Mond gas as yielding 125 units, the volume required would be about 6 to 1. This would have a very important bearing on the question of economy and the relative prices of the two gases. There was another point in connection with the calorific value which was not generally understood, and that was the production of sulphate of ammonia.

Those who were familiar with the process employed for the recovery of sulphate from producer gas, were aware that making gas of high calorific value meant a considerable sacrifice of ammonia. But the Mond Gas Company were depending for their commercial success to a considerable extent upon the yield of sulphate; and therefore there would be a great temptation for that and similar companies to impoverish the gas supplied to the consumers in order to keep up their revenue. To make gas of high calorific power required an increased temperature in the producer, which meant the dissipation of a greater quantity of nitrogen, and hence a less production of ammonia. On the other hand, by keeping down the temperature of the producer, there was an increase in the yield of ammonia, but the gas suffered in calorific value. Unfortunately, many people who were going to use Mond gas if the Bill passed, lost sight of this important point. It would have to be faced, however; and personally he did not think gas companies and local authorities had much to fear from the competition of this gas. At the present time, he was supplying gas at 1s. 1d. per 1000 cubic feet for motive power, which he thought would work out quite as economically as Mond gas of 125 units. They gave 77 cubic feet of gas for 1d. With a modern Crossley engine it was claimed that 15 cubic feet would produce 1-horse power; so that at this price the consumer would get 5 brake horse power for 1d. In order that electric energy might be comparable with this, it would have to be supplied at ¼d. a unit. On the whole, therefore, he had not much fear of the competition of producer gas with coal gas for power purposes.

Mr. C. Elliott (Leyland) asked if Mr. Clerk could tell them how the cost of power, using the gas he recommended, of 600 thermal units, at 1s. per 1000 cubic feet, would compare with the cost of steam power—say, a 100-horse power engine. He had had some experience with a gas-engine of this size, worked with 16 or 17 candle gas (which, he supposed, produced about 700 thermal units), at 3s. per 1000 cubic feet. The engine was employed to produce electric power, and the people using it said it was several times dearer than steam. If this were so, he did not see how gas of 600 thermal units, even at 1s. per 1000 feet, could be as cheap as steam.

Mr. Dugald Clerk, in reply, said the cost of Dowson gas, at 2d. per 1000 cubic feet, included everything. In a Dowson gas plant of (say) 50-horse power, applied in the works, there were no distribution costs; and this was a matter which the Mond people seemed to have forgotten. Dowson gas could be made in the works at about 2d. per 1000 cubic feet, with anthracite at about 24s. a ton. In answer to Mr. Paterson, he might say that blue water gas worked very well in gas-engines, and was used in some places, but not much in this country, because, although it had quite as high a flame temperature as ordinary coal gas, the number of heat units it gave out per cubic foot was only about 300. This was exactly double what the Dowson gas gave; but, on the other hand, the water gas was much more expensive. Dowson gas in the gas-engine took the place of a steam-boiler. If a steam-boiler was supplied with fuel, one could get in an ordinary boiler about 70 per cent. of the heat evolved in the form of steam—in some boilers as much as 85 per cent. had been obtained. With a modern Dowson gas producer, one could get, with fair use, an efficiency of upwards of 70 per cent. There had been tests which showed as high an efficiency as 80 per cent. With a good anthracite, from 75 to 80 per cent. was not unusual. Consequently, in a Dowson plant they had the equivalent of a steam-boiler. The only thing which kept it from being as cheap as steam was the fact that anthracite or expensive coke had to be used instead of slack, costing 9s. or 10s. a ton, such as was often employed for steam raising. In the case of blue water gas, on the other hand, the efficiency of conversion was not so high. They had to make a certain quantity of producer gas for blowing up; and the efficiency of the producer as a heat instrument was not high. One could not get the same economy as would be obtainable by using the weaker gas. Mr. Paterson asked why ordinary gas was out of the field for large gas-engines. It was simply a matter of price. It would not be shut out if they could supply it cheaply enough; but so long as it cost 2s. per 1000 cubic feet, he feared it would. When gas came to about 1s., as in Mr. Carr's case, the field was very much extended; but even at that it did not quite come down to what a steam-engine could do. Of course, he did not mean a small steam-engine, which was not very economical, but one of anything like 100-horse power. With such an engine, the fuel costs in some cases did not exceed ⅛d. Mr. Carr's figures came very near that—viz., ⅛d. Mr. West was quite right in saying that 1 cubic foot of Manchester gas was equal to about 5 cubic feet of Dowson gas; but he (Mr. Clerk) thought he was wrong in putting the cost of Dowson gas so high as 6d. Nowadays there was no justification for such a cost, unless the question of distribution came in, which, of course, made all the difference. He was much interested in what Mr. West had told them about the large gas-engines in America, which he had read about, but had not yet seen, although he hoped to do so before very long. They were certainly doing something with large gas-engines over there; but he did not think they had got ahead of us. Our Continental brethren had gone a little ahead for a time; but he did not think it would be for long. Mr. Carr had asked about the relative efficiency of coal gas and producer gas—by which he (Mr. Clerk) understood him to mean the heat efficiency. So far as economy from a heat point of view was concerned, as large a heat conversion could be obtained in an engine using Dowson gas, as in one using coal gas—the proper mixture being employed in each case. They could get from 78 to 80 per cent. of the heat converted into work, though it was quite true that the engine using producer gas must be somewhat larger—about 20 per cent. This, however, did not apply to very large engines, in which it was hardly safe to use the temperatures one could get with coal gas; though in smaller ones it might be done. Gas engine makers all liked to have coal gas to work with—not entirely on account of dimensions or efficiency, but of certainty in working. If they had a gas of high inflammability, and a considerable flexibility in the ratio of mixture which would ignite, they had a better gas; and this they had in coal gas. If anything went wrong with the producer, the margin allowable in the strength of the gas was so small that there might be a considerable loss in efficiency. This was the disadvantage of using producer gas. If the quality of it were not uniform, the efficiency went down, and a bad diagram was the result. There was nothing of this sort with coal gas, because it was so admirably uniform in composition. He, for one, should be much easier in his mind, running a large engine with coal gas than with producer gas; but it was entirely a question of cost. With gas at 1s. 1d. per 1000 cubic feet yielding 650 thermal units, they should be able to compete with the steam-engine, up to 100-horse power, quite easily. Very few steam-engines worked as economically as ⅛d. per horse power; and ⅛d. was getting near to it. But he should fancy coal was particularly cheap in Mr. Carr's district. It was convenient to have an engine without a boiler; and he should think large gas-engines would soon come into use there, when people got to know about it. He quite agreed that electricity would have to be supplied at ¼d. a unit to compete with gas-engines. The great point in favour of a steam-engine was that one could get an indicated horse power for about ⅛d., using cheap fuel—slack at about 8s. per ton. If the same fuel could be employed, it would be possible to get a gas-engine to give this amount of power for about $\frac{1}{16}$d., if they could get the producer up to the efficiency of the steam-boiler. This was the problem at which gas engineers were working now, both in England and on the Continent. They were attempting to make gas producers which had no gas-holders—"suction" producers they were called, which would work with bituminous fuel. If they could get a producer of something like 70 per cent. efficiency, using ordinary slack, they would have 1-horse power for $\frac{1}{16}$d. as the cost of fuel; and he believed this would yet be achieved with large gas-engines.

The President said he had really nothing to add to the interesting discussion; but he might say that he had heard lately of a case in his district, where a gas-engine driven by Dowson gas was in use, the proprietors being afraid of the cost of ordinary gas. But he understood they used coal gas to start the engine.

Mr. Dugald Clerk remarked that this was a very usual practice.

The Central Hackney Liberal and Radical Association have unanimously adopted Mr. E. W. T. Richmond as the Liberal candidate at the next election. This seat has been held by a Conservative since 1885; the sitting member being Mr. A. H. Allhusen. The last Liberal member to represent the constituency was the late Right Hon. Henry Fawcett.

THE VALUATION OF GAS OILS.

By JOHN P. LEATHER, of Burnley.

The "Transactions" of the Gas Institute are not without some information as to the quantity and quality of gas to be obtained from oil by various processes. There is, however, probably room for considerable increase in the knowledge we possess of the properties required of a gas oil, and how these are to be determined. When, a few years ago, I contemplated the erection of a carburetted water-gas plant, I understood that there was practically no great difference between one petroleum oil and another—provided, of course, that the oil used was that boiling between certain customary limits.

After the erection of our plant, we obtained very good results from the Russian "solar" distillate, which we purchased for our first season's working. The following season we bought a cheaper oil, which was raised in Borneo. The poor results led to an examination, which soon disclosed important differences in the chemical composition of the oil, as compared with that previously used. My colleague, Mr. Raymond Ross, F.I.C., and I determined to enter on as complete an investigation as possible into the constitution of the various gas oils on the market. Mr. Ross went into the matter with such enthusiasm that we soon had a large volume of facts, which are duly set forth in a joint paper read before the Society of Chemical Industry in Manchester last month.*

Instead of giving a consecutive history of the various steps through which we were led in our experiments, I propose to briefly set forth the constitution of the different classes of hydrocarbons found in petroleum and in this way lead up to a consideration of the reason for variations in the gas-producing qualities of these oils. If we know the reason for such variations, we can better understand what tests to apply as a means of commercial valuation.

Hydrocarbons may be divided into two classes—the open-chain and the closed-chain compounds. The open-chain compounds are subject to decomposition or cracking with a moderately elevated temperature. The more carbon atoms contained in the molecule, the lower the temperature at which cracking commences. Indeed, with the higher compounds, cracking begins at temperatures below those at which they boil under the ordinary atmospheric pressure. It is, therefore, only possible to completely distil these without change by the use of reduced pressure. This cracking at first means simply the division of the molecules into similar molecules containing a smaller number of carbon atoms; the new bodies being also liquids at the ordinary temperature, so that practically no gas is made. The compounds formed are open chain compounds. Olefines produce olefines; paraffins produce paraffins and olefines. As the temperature is raised, the decomposition becomes more thorough, and hydrogen and marsh gas are split off together with olefines. Marsh gas is undecomposed, even at exceedingly high temperatures. At a high temperature, however, there is a tendency to produce acetylenes; and an opposite action commences. The acetylene polymerizes to benzene; and at still higher temperatures further condensation takes place—other closed-chain compounds, such as naphthalene, being formed.

The fact that these closed-chain compounds are formed at high temperatures necessarily means that these compounds are exceedingly stable at high temperatures. If, therefore, our oil contains closed-chain compounds to begin with, we should expect that they would not help to produce any quantity of gas. These compounds may indeed be cracked at a very high temperature; but the cracking results largely in coke and pitch, with but little gas, and that of practically no luminosity. This has already been pointed out by several workers—notably by Mr. W. Irwin, in communications to the Society of Chemical Industry.

In speaking of closed-chain compounds, it must be remembered that these are of two kinds—those which are homologous with benzene, and are unsaturated, and those which contain a larger quantity of hydrogen, and are known as naphthenes or cycloparaffins. These latter have not been so thoroughly investigated by chemists, but are generally found in greater or less quantity in all petroleums, and constitute the determining factor in producing the inferior results obtained when cracking Borneo oil. Though the naphthenes may yield rather more gas than the benzene homologues, the gas contains practically no illuminants. It is also evident that, if we endeavour to crack a mixture of paraffins, olefines, and naphthenes, on the one hand a temperature producing good results with the paraffins and olefines will be insufficient to decompose the naphthenes; while, on the other hand, a temperature sufficiently elevated to crack the naphthenes will overcrack, and entirely spoil the gas obtained from the paraffins and olefines.

It will therefore be seen that the value of a gas oil is practically proportioned to the percentage of paraffins and olefines present; the benzenes and naphthenes being of no value except as tar. The analysis of an oil to determine what percentage of these compounds it contains is not very simple. The aromatic compounds and olefines can be determined by sulphonation, and by the action of bromine and Nordhausen sulphuric acid. The relative quantities of the paraffins and naphthenes may be approximately estimated by taking portions separated by fractional distillation and determining the specific gravity and refractive index. For compounds boiling at the same temperature, both the specific gravity and the refractive index are much higher for the naphthenes than for the corresponding olefines or paraffins. The specific refraction $\left(\frac{\mu - 1}{d.}\right)$ is, however, higher for the olefines than for the paraffins; and in this respect the naphthenes do not differ much from the paraffins—at least, for the single-ring compounds.

Having thus briefly sketched the lines on which an oil may be examined, I will give a concrete instance of the method of deduction to be employed. Five different samples of oil were taken. They were separated by distillation into a number of fractions, each of which was separately examined. I do not propose to recapitulate the whole of the figures obtained, but simply to indicate the general character of each oil. The following table will show how they differed one from another:—

No.	Source of Oil.	Specific Gravity.	Refractive Index at 25° C	Specific Refraction.	Boiling Point.
1	Russia	·825	1·4521	·548	115—300° C.
2	Russia	·872	1·4794	·549	200—430° C.
3	America	·851	1·4723	·555	150—420° C.
4	Borneo	·901	1·5067	·562	170—330° C.
5	Texas	·883	1·4806	·544	200—380° C.

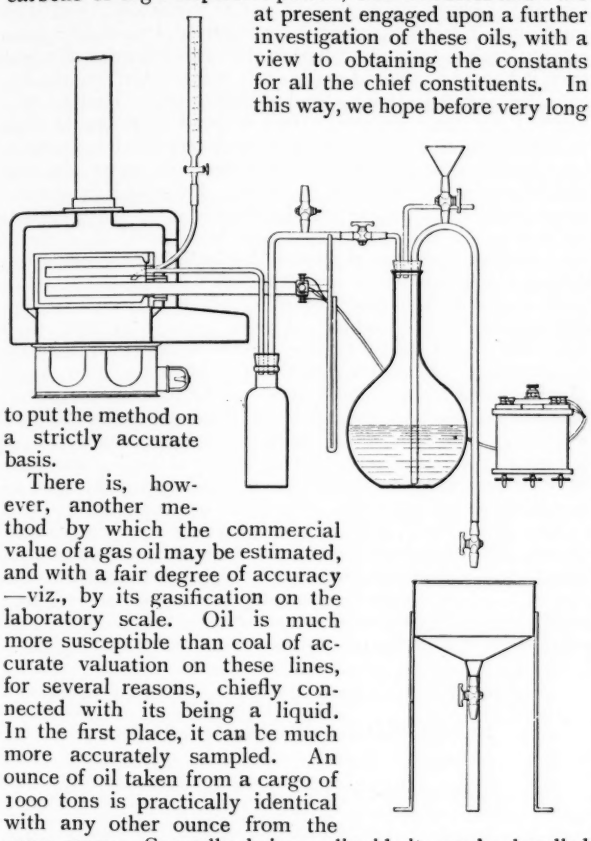
It will be seen that No. 1 oil has a much lower gravity than No. 4, although its boiling point is nearly as high. Nos. 2 and 3 actually boil at a much higher temperature, and yet do not reach the gravity of No. 4; nor is their refractive index so high. A specific gravity of ·901, coupled with a boiling point below 330° C., is a sure sign of the presence of closed-chain compounds. As this oil, on being shaken with concentrated sulphuric acid, is found to have no appreciable quantity of aromatic compounds, it evidently contains a large proportion of naphthenes.

On comparing the specific gravity and refractive index of No. 5 with the figures for Nos. 2 and 3, similar differences are observed, though not to the same extent as in the case of No. 4. It was also found, on shaking with concentrated sulphuric acid, that about 5 per cent. of the oil dissolved in the acid, showing the presence of that amount of the homologues of benzene. These have a greater effect on the gravity than the naphthenes; but in this small quantity they would not suffice to raise the gravity so high as that found. This oil, therefore, also contains a considerable quantity of naphthenes. When the relation between the refractive index and the gravity—*i.e.*, the specific refraction—is examined, further peculiarities are noticed. No. 5 has the lowest specific refraction; Nos. 1 and 2 give slightly higher figures; while those for Nos. 3 and 4 are much higher. This points to the small percentage of olefines in No. 5, as also in Nos. 1 and 2, compared with No. 3, and to the large percentage in No. 4. This deduction is entirely confirmed by other experiments, in which the amount of olefines was determined in the different fractions by means of bromine, and also by the action of Nordhausen sulphuric acid.

When this method of deduction is applied to fractions of the oil boiling within a small range of temperature, it is possible to calculate approximately the relative proportions of the different constituents. To do so with accuracy, however, it is necessary to know the specific gravity and refractive index of a number of compounds which have not yet been prepared in the pure form. By determining the vapour density of a fraction, and thus deducing the number of

* See "JOURNAL," June 10, p. 1561.

carbon atoms in the molecules, it is possible to calculate the specific refraction of the component bodies by Brühl's law. This law does not, however, give accurate results for hydrocarbons of high dispersive power; and Mr. Ross and I are at present engaged upon a further investigation of these oils, with a view to obtaining the constants for all the chief constituents. In this way, we hope before very long to put the method on a strictly accurate basis.



There is, however, another method by which the commercial value of a gas oil may be estimated, and with a fair degree of accuracy—viz., by its gasification on the laboratory scale. Oil is much more susceptible than coal of accurate valuation on these lines, for several reasons, chiefly connected with its being a liquid. In the first place, it can be much more accurately sampled. An ounce of oil taken from a cargo of 1000 tons is practically identical with any other ounce from the same cargo. Secondly, being a liquid, it can be handled more readily, and can be passed into a retort without loss at any required rate. Thirdly, as the retort has not to be opened for the reception of the charge, the temperature can be exactly regulated.

The apparatus Mr. Ross and I have designed for this purpose is shown on the diagram. An iron retort is heated in a gas muffle furnace to a temperature which is measured accurately by an electrical pyrometer. The oil is passed slowly in by a tube projecting a short distance into the retort; while the gas produced leaves by a tube reaching nearly to the back. The gas is collected, measured, analyzed, and its specific gravity determined. The whole working of the apparatus, together with the following table of the gasification of oils, will be found in the paper already referred to, in the "Journal of the Society of Chemical Industry."

—	Russian Solar Oil.	Borneo Solar Oil.	American Solar Oil.	Texas Solar Oil.	Russian Refined Oil.
Quantity of gas per c.c. of oil, corrected to N.T.P.	465·7 c.c.	301 c.c.	442·6 c.c.	397·4 c.c.	429 c.c.
Density (air = 1)	0·833	0·765	0·885	0·737	0·775
Weight of gas made per c.c. of oil.	0·502	0·298	0·506	0·388	0·430
Tar by difference, per cent.	42·5	67	40·5	57	47·9
Analysis of Gas.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Hydrocarbon vapours	4·0	4·0	3·2	3·4	3·8
Heavy hydrocarbons	30·2	22·8	33·0	26·8	28·0
Methane	54·2	60·0	52·5	56·2	57·0
Hydrogen	12·0	13·6	11·6	13·4	11·5

This gives the results of the gasification of the five oils already referred to at a temperature of about 1350° Fahr. Further experiments have been made with all these oils at a variety of temperatures to determine the best results, as measured by the product of the quantity of gas produced into the sum of the percentages of the hydrocarbon vapours and heavy hydrocarbons contained in the gas. Seeing that the illuminating power of the gas is dependent on the two latter quantities, this product may fairly be taken as proportional to the commercial value of the oil for gas-making purposes. The following table gives the best results from each oil, with the temperature at which they were severally obtained:—

No.	Source of Oil.	Temperature Fahr.	Percentage Ungasified (Tar).	Quantity of Gas.	Hydrocarbon Vapours and Heavy Hydrocarbons.	Product.
1	Russia	1510°	39·6	518	28·4	14,711
2	Russia	1360°	42·5	466	34·2	15,927
3	America	1360°	40·5	443	36·2	16,022
4	Borneo	1510°	54·6	472	17·0	8,024
5	Texas	1350°	57·0	397	30·2	12,001

It is evident from this table that gas oils may vary very greatly in their value, and that before making purchases of oils from new fields the value of the oil should first be determined; and I have ventured to submit the above method of valuation devised by Mr. Ross and myself as a suitable and efficient one for the purpose.

I have thus far assumed that the oils contain no compounds of other elements than carbon and hydrogen. The gas oils usually put before us in this country are in general practically free from acid and basic compounds. In examining a strange oil, it is, however, advisable to determine definitely the absence of these bodies, which can readily be done by observing the effect of shaking with alkali and acid respectively. A further element of importance is the quantity of sulphur. This is best determined by a modification of Allen's method of estimating sulphur in fats. A weighed quantity of the oil, mixed with nine or ten times its volume of absolute alcohol, is burnt in a small lamp under the trumpet tube of a Referees' apparatus; the other details being precisely as in the estimation of sulphur in gas. Samples of "solar" oil tested in this way have given results varying from 0·05 to 0·2 per cent. of sulphur.

Discussion.

Mr. G. R. Hislop (Paisley) said he had heard this paper with great pleasure and profit. One could see that the author had gone very carefully into the matter; and the result of his experience ought to be of much value to the members. He (Mr. Hislop) had been working for some years on oil, but on different lines from those on which Mr. Leather had proceeded. What he did was to make illuminating gas pure and simple; and he agreed with the author that considerable differences arose from variations in temperature and volume. In his own case, this had been the real difficulty in getting the best results from his apparatus; but, after four years' working, they had now got fairly in the way of knowing the temperature required for the class of oils generally employed—viz., Scotch oils. He had not had any experience of American, Russian, or Borneo oil, as he obtained an abundant supply from Scotch manufacturers. No doubt they were in the best field in the world for getting the results Mr. Leather had indicated. The fact the author had brought out was the importance of ascertaining the value of oils before purchasing any considerable quantity; and the secret of success depended largely upon knowing the temperature at which to employ the different oils.

Mr. C. S. Ellery (Bath) said there were two points on which it might be of interest to those who had to use these oils if Mr. Leather could give a little further information, especially now that newer oils were coming into the market. If he followed Mr. Leather, he introduced the oil into the iron retort at the temperatures named, and what he (Mr. Ellery) wanted to know was what would be their behaviour on coming into contact with the heated surface—whether there was not a danger of their cracking and liberating the free carbon. He had made a large number of experiments; and the difficulty he found in treating the oils at these high temperatures was that they had stopped pipes, and an interference with the actual determination of the value of the oil. He should also be glad to know what pyrometer Mr. Leather used, because it was not easy to ascertain these temperatures exactly. However, he seemed to have obtained very accurate figures.

Mr. S. Y. Shoubridge (Sydenham) thanked Mr. Leather for his valuable contribution on a subject about which very little was known. All engaged in the manufacture of water gas felt it was desirable to have a ready means of testing any oils submitted to them. Hitherto they had to buy oils very much in the dark; the only source of information being the persons who had the oils to sell. It was very fortunate that Mr. Leather had devoted his exceptional ability to the consideration of this subject; and he (Mr. Shoubridge) was glad to hear the promise that he had made to continue his

experiments, and let the gas profession have the advantage of his further research.

Mr. T. O. Paterson (Birkenhead) said that all who used water-gas plant must be much indebted to Mr. Leather for his paper, seeing that carburetted water gas now had an important part in the gas industry, and the oil they were dealing with had a very valuable part in the production of this gas. He must say they had had some very mysterious workings from time to time; but, when they studied this paper, they would perhaps be able to discover something which would enlighten and no doubt benefit them.

Mr. Leather, in reply, said he could hardly expect a very full discussion on his paper; but there was a good deal that might have been added which would have made the paper much longer. But, although in a short compass, on careful reading, the members would see that there was more in it than at first appeared. With regard to the Scotch oils to which Mr. Hislop referred, he had not had a sample of this class submitted to him, nor had he purchased any, because it would probably be out of the question on account of the cost of carriage. If, however, he came across a sample, he should be glad to try it. He believed the Scotch oils had a very large proportion of paraffins, and that the naphthenes would be very low, though they were not altogether absent. A paper read by someone interested in Scotch oil a few months ago, spoke definitely of the naphthenes in their oil, although they evidently had not had sufficient time for a thorough research. He was glad that he was in a position to undertake this kind of work, having a very enthusiastic Chemist—the Corporation Chemist—to aid him, a well fitted-up laboratory, and two or three assistants; and he hoped to put a good deal more time into this question, and probe it still further. With respect to Mr. Ellery's question whether the oil coming in contact with a heated surface would overcrack, this was avoided because the retort was kept at a constant and proper temperature as compared with carburetted water-gas plant. In the case of heating up the brickwork in the superheater, some portion of the brickwork might be much hotter than others. There were also great variations at the point where the oil went in; the temperature during the time of a five minutes' run varying through as much as 500° and possibly 600° Fahr. They had an Economical Gas Apparatus Construction Company's plant; but the same thing applied to Messrs. Humphreys and Glasgow's. The lower portion of the apparatus, which they called the superheater, was heated up to a high temperature—to a bright yellow heat. The oil was put in above that. The upper portion above the point where the oil entered was, generally speaking, at a fairly constant temperature—about 1250° to 1300° Fahr. He put the pyrometer in on one occasion just at the point where the oil was injected. During a three minutes' blow, it went up so rapidly that he could hardly follow it. The pyrometer used was contained in a steel case, which protected a porcelain tube, inside which there was a mica frame, on which was wound a fine platinum wire. They really measured the electrical resistance of this fine platinum wire, from which the temperatures were known. It was made by the Scientific Instrument Company, of Cambridge, under Professor Callendar's patent; and the figures were read off direct. There was an indicator, which was strictly speaking a Wheatstone bridge arrangement, with resistances and a circular bridge wire. By turning a knob, a sliding contact was moved, and greater or less resistance put in, until the galvanometer needle balanced; and when this was done, the pointer indicated the temperature. It could be measured, if it did not vary up and down rapidly, to 1°. It was a very accurate instrument; and they had used it inserted in the superheater, as well as in the experimental retort. But when put in at the point where the oil was injected, at the beginning of the blow, the temperature would be considerably below 1000°. It would go up very fast during the run; and one could hardly keep the galvonometer needle from swaying too much to one side, so as to follow its movements. It read on the platinum scale, and not on the air scale, and varied from about 900° to 1400° on that scale. Something like 100° would have to be added to the 900°, and about 180° to the 1400°, to make the calculation for the air thermometer. The cost of the pyrometer was about £7, and of the indicator £15 15s. With regard to carbon being formed, the retort was heated up by gas until the pyrometer showed the temperature it was wanted to work at. By this time, the fire-casing round was probably much hotter than the pyrometer; but they found that if they turned out the gas at once, and commenced the experiment with the pyrometer, which only took a few minutes, the temperature was practically the same. The oil, at the rate they were putting it in at, took up the heat about as fast as the brick-casing gave it out to the retort; and thus there was a fairly constant temperature. Practically there was no carbon formed, except in the case of Borneo oils, and then it had to be cleared out once or twice. Mr. Shoubridge said they wanted some method of testing oils. Perhaps this method was more elaborate than most of them would wish to put in practice; but they might get very good indications by a Zeiss refractometer, and distilling the oil at different temperatures into different fractions. By trying these fractions in the refractometer (and only one drop was wanted, so that merely a small flaskful need be distilled altogether), the relations between the refractive index of the oil at the different boiling points would at once be seen. If there were a considerable quantity of naphthenes as indicated by the high refractive index and high specific gravity, they must not expect the oil to give good results. This was only a vague test; but still it was a help. He hoped that, when Mr. Ross and himself had gone on with this work somewhat further, and had got the actual constituents of the oil, they would be able to put the analysis of the oil, apart from testing in the retort, on a thoroughly good basis; and they were certainly trying their best to get it done as soon as possible.

The President said this had been a most interesting paper. He was afraid sometimes the price per gallon of oil was the only thing gas managers looked to in making purchases; and an unpractical mind might easily fall into that error. What, however, they really wanted to know was what there was in the oil which was useful for making gas.

AUTOMATICALLY LIGHTING AND EXTINGUISHING PUBLIC LAMPS.*

By W. R. Mealing, of London.

The subject of dealing with the lighting and extinguishing of public lamps by a reliable automatic system has considerable interest for gas engineers; and the need for such a system has been fully shown in the discussions which have been contributed to such gatherings as the Gas Section of the Glasgow Congress last year. The need has been felt a long time; for the difficulties experienced with lamplighters, whose service in many places is very unsatisfactory, have been and still remain a cause of tribulation to many gas engineers. But the question has perhaps come more immediately to the front of late because of the competition of electricity in public lighting, and the consequent desire of the gas industry to utilize improvements not only in gas production, but also in distribution, which effect substantial economies, and help to render gas lighting unassailable in the matter of cost. Further, attention has been drawn to the subject by the published results of the efforts of inventors to supply an effective automatic lighting system, and by the trials made by prominent gas engineers of various apparatus submitted to them.

The lines upon which different men have worked in the endeavour to achieve an efficient system may be roughly classed as having two distinct aims. On the one hand, the aim has been to perfect a circuit system which should control a large number of lights from a central position; and on the other, to devise a reliable apparatus which should work each lamp separately and independently. So far as the results at present show, it would seem that no system devised to control the lighting up and extinguishing of a section of lights from a central point is likely to be free from the disadvantages of great cost of installation and great difficulty of repair should breakdown occur.

With a circuit system, whether worked electrically or by other methods, a breakdown will affect many, if not all, of the lamps in the section; and to locate the cause of failure, and remedy it, will cost much time and labour. But in a system which works each light, or cluster of lights, separately, this disadvantage does not exist, since a breakdown, if it does occur, affects only one lamp, and the failure is easily observed and quickly remedied. A further advantage of the separate system is to be found in the fact that the apparatus, where required, can be made to actuate a mid-

* The author exhibited the arrangement described, affixed to a number of burners of different makes. The appliance was fully described in the "Journal" for April 15, p. 950.

night arrangement in a cluster of burners—an operation which the circuit system cannot satisfactorily accomplish. An apparatus to work each individual lamp, therefore, appears to be the practicable method of dealing with the problem; and this, I believe, is the view of the leading gas engineers who have interested themselves in the subject.

There are several essential requirements which such an apparatus must fulfil. It must be a real economizer, working automatically for such a length of time that the saving in labour will be substantial. It must be simple in adjustment, so that the alterations of time for actuating the lights may be easily and quickly carried out by an ordinarily intelligent workman. It must work accurately, so that the turning on and off of the lights at the times required may be fully relied upon. It must be compact, so that if placed in the lantern it may occupy little space and throw no shadow; and it should be durable, to withstand changes of temperature, and wear and tear, without developing irregularities. And, finally, it should be adapted to fixing to the burners and supply pipes at present in use, and with a minimum of trouble.

The object of this paper is to give a short description of an appliance upon which Mr. John Gunning, of Bournemouth, has been working for the past five years, with a view to perfecting an apparatus which will fulfil these conditions. The principle of the apparatus is a simple one. The inventor devised a rotatory tap, pierced with gas-ways to feed one or more burners, and a bye-pass. The tap is contained in a junction-piece 2½ inches in length, which is made to screw to the top of the supply-pipe, and also to receive the burner on the top of the connection formed by it. The tap is fitted with a star wheel, which is so placed that each cog becomes engaged by a slowly revolving pawl, and the movement of the tap effected by this means opens the gas-way to the full extent. The movement of the next cog by a second pawl closes the main gas-way and opens the bye-pass.

For the motive power for the pawls, a clockwork mechanism was chosen; and it was ultimately found that a strong and reliable clock of good workmanship best met the requirements. A very powerful spring, acting by means of the pawl direct upon the rotary tap direct upon the escapement, is enclosed in a small brass case, which is fixed at the bottom of a larger case containing the remainder of the clockwork; the whole forming a strong and practically dust-proof cylindrical brass case 3½ inches in diameter. The spindle of the clock is carried through from the spring to the front of the case, and has fixed to it a flange about ½ inch or so in front of the case face. In front of this fixed flange, and working round the spindle, is a movable disc which is perforated with 24 holes, each hole representing one hour; and in front of the disc, also working around the spindle, are the pawls which are also movable, and each of which is pierced with a hole through which a screw runs. With this screw each pawl can be fixed into any one of the 24 perforations in the disc, and both pawls and disc screwed firmly on to the flange. When securely screwed, and the clockwork wound up, the disc makes one revolution in 24 hours, and works in this manner for one week.

The clockwork mechanism is fastened to the brass junction-piece in which the gas-tap turns, and is so placed that each pawl of the clock in revolving engages one of the cogs of the gas-tap. The movement of one of the cogs by the pawl turns the light full on, and leaves the next cog in position to be engaged by the next pawl of the clock in rotation—this second movement of the gas-tap extinguishing the light. Thus two pawls attached to the clockwork disc revolving once in 24 hours will actuate the tap twice in that time—the movement of the first cog turning the light on, and the second extinguishing it—at the hours at which each of the two pawls is fixed.

The gas-way for the bye-pass is arranged for the pilot light to be extinguished when the lamps are alight, and the bye-pass pipe is regulated at the top, so that the pressure of gas is carried right up to the flame, with a view to minimizing the danger of extinction in rough weather. For working a midnight arrangement in a cluster, the tap has an additional gas-way supplying the burner which is to remain alight until daylight, and three pawls instead of two are used on the clockwork apparatus. The first pawl turns on all the lights, the second turns off the midnight lights, the third turns off the daylight burner. With clusters of incandescent burners, the bye-pass pipe is branched, so that a pilot-jet is alight at each burner when the flame is lowered.

The clockwork used runs for one week when wound, and although the apparatus could easily be made to work for a fortnight or even longer without re-winding, the weekly mechanism was adopted since it is considered that each lamp should be visited once weekly for lantern cleaning, re-setting times of lighting-up, &c.

The method of setting is very simple. Having loosened the screws which fix the pawls and the disc, the operator places the disc in such a position that the hour at which he is winding the apparatus is in exact line with a straight mark made on the supply tap for the purpose. He then fixes the pawls respectively to turn the light on and off at the required hours to follow. Thus, if the hour at which the attendant winds the apparatus is at 11 a.m., and the light is required to be turned on at 7 p.m. and extinguished at 5 o'clock next morning, the attendant places the number 11 exactly opposite the mark on the supply-tap, screws the "on" pawl into number 7 hole following it, and the "off" pawl into the number 5 hole following that. The apparatus actuates the light at these hours until reset. It will be noted that hours only are marked upon the disc; but if, at the time of setting, the disc is placed fast or slow in relation to the actual time, quarter-hour differences in lighting up can be secured.

The essential necessity in such an apparatus is that the clockwork mechanism shall be accurate and reliable, and that the pilot-flame shall not fail. After prolonged investigation, Mr. Gunning adopted the mechanism above outlined; and it has successfully met severe tests in towns where the apparatus has been installed in the public lamps. Engineers in different parts of the country have been supplied with it, and the inventor has received reports as to the accurate working of the system. It may be mentioned that in a town so near as Bournemouth a considerable number of the appliances have been in use for some three years, and have given every satisfaction; but it should be added that the first installation adopted there was designed to extinguish the lights only, and that the use in that town of the appliance as now shown to the meeting—*i.e.*, to turn on as well as to extinguish the lamps—is more recent.

It is hardly necessary to mention to a meeting of gas engineers the savings that can be effected by a system of this kind, if the requirements of reliability and durability are fulfilled. As to labour, an attendant working a full day of eight hours will, it is computed, be able to wind and set from 800 to 1000 lamps per week, and the apparatus, by turning on and turning off the lights at the times actually required, should also effect a saving in gas consumption.

The apparatus has been successfully used with high-pressure self-intensifying lamps, and a series of tests with incandescent burners has shown some interesting results, as the turning on of the gas is so gentle that the danger of lighting-back seems entirely removed. The use of the apparatus is also likely to prolong the lives of mantles very considerably, since injurious explosion and also the jerking of mantles at the time of lighting are done away with.

As to the bye-pass, it is, of course, necessary for a reliable pilot-light to be used with apparatus of this kind; and the steps taken by the inventor to ensure against the failure of this light have been shown. But the supplying of the bye-pass pipe as part of the appliance necessitates that the pipe should be of the correct length for each of the many different burners, with anti-vibrators and other attachments used in public lighting. The cost of the gas consumed by the pilot-lights must also be taken into account, although this expense is dwarfed by the large economies effected by an efficient and reliable automatic lighting system.

Discussion.

Alderman MILES (Bolton) asked how long the appliance had been in operation both for lighting and extinguishing at Bournemouth, and also where one could be obtained for trial previous to adopting it on a large scale. He should also like to know something about the cost.

Mr. S. Y. SHOUBRIDGE (Sydenham) said the members would all agree as to the great utility of such an apparatus, if it was thoroughly reliable. If the inventor had succeeded in producing mechanism which would withstand changes of temperature, he had done something to deserve the thanks of the gas profession. He had himself had ten of a somewhat similar arrangement in use in his district for six months; but, although they had been under the personal care of the London agent of the firm who supplied them, he was sorry to say the large number of failures precluded the possibility

of introducing that particular system. He should be glad to hear how long this appliance had been in use in any place, and what had been the percentage of failures. Clocks were always liable to get out of order. He had several in his house; and there were not two alike. This was one of the difficulties of this kind of apparatus.

Mr. E. Jones (Pontypridd) said that anyone who brought out anything which would assist them in improving the conditions of gas lighting deserved the thanks of the Institute, for, as they all knew, one of the greatest scares of gas managers were the lamplighters. He had tried several kinds of similar mechanism, but had failed to get the satisfaction anticipated; and a really good automatic lighter for street-lamps would be heartily welcomed. Of course, there would have to be the same supervision over the lamps as regards cleaning; but, if they could only save the leakage, which he thought was considerably higher than was generally estimated, it would be a good thing.

Mr. W. W. Hutchinson inquired what were the author's principal objections to the circuit system, and what was his actual experience of it. It seemed to him this system had been rather cavalierly dismissed by the author.

Mr. R. Fish (East Cowes) said he was pleased to see this arrangement brought forward, as he had taken a great interest in the matter. He had had one under very severe test for some time; and he was so pleased with the result that he had requested the maker to fit up forty lamps. He thought there was a great future for these instruments, because every gas manager, whether of a large works or a small, had at times considerable difficulty with lamplighters in getting the lamps lighted and extinguished at the proper time. About the time he joined the Institute in 1870, an able paper was read describing a patent lamplighter; but, simple as the appliance was, there were found to be many difficulties in its working. It was, however, sometimes simple things which took the longest to learn; and some people never learnt them at all. This was a simple arrangement which the author had described; and he (Mr. Fish) had not found any difficulty with it. He hoped it would prove a success, and make things a little easier for gas managers throughout the country.

Alderman Miles suggested that the makers should be prepared to put up a few on approval in any representative town, where they could be thoroughly well tried.

Mr. Mealing said the inventor would be pleased to supply any number, according to the importance and size of the town, for free trial for about two months, so as to give an opportunity for the apparatus to be thoroughly tested, and either continued in use or returned if it did not prove successful. The actual cost of the arrangement was 30s. each, and for the midnight arrangement 35s. each. But the success which had attended it in many cases had induced the inventor to supply the apparatus at an annual rent of 5s., so that it could be introduced without a large outlay of capital. He was not in a position to give any figures as to the percentage of failures, as it had only been within the last few months that a considerable number of the apparatus, running up to hundreds, had been supplied to different gas engineers throughout the country, who were now testing them. They would hear from time to time certainly of any failures that occurred; and he should be pleased to send Mr. Shoubridge the figures. Up to date, he did not think they had been very large. A clockwork arrangement was of necessity not always to be relied upon, unless made under the best process of manufacture. The apparatus had been used for many years now; and the principal difficulty they had had to contend with had been the unreliability of the clockwork arrangement. They did not say it was perfect yet; but they knew, from the results of the last six months, that it was of great utility, and the percentage of failures in one or two cases was absolutely *nil*. Mr. Humphrys was not then present, or he could have spoken of the results he had obtained with a dozen of the apparatus during the last six months at Salisbury. He had told them they were in every respect satisfactory; and he had now decided to have them fitted to the high-pressure self-intensifying Welsbach burners there. At Bournemouth, the new apparatus for both lighting and extinguishing had only been used a few months; but the apparatus for extinguishing the lights had been used for some years. The Corporation were adopting it there for use with the high-pressure self-intensifying burners of the Welsbach pattern. He could not answer Mr. Hutchinson directly as to the failure of the circuit system of lighting and extinguishing, but would procure particulars.

A NEW SYSTEM OF GAS MEASUREMENT.

By T. G. Marsh, of Manchester.

A new departure has recently been made in the system of gas measurement. It is introduced with a view of furthering the efforts of gas engineers in the exercise of their profession, and to assist them in deciding upon the values of the various methods of manufacture and distribution now claiming attention.

Before entering upon the merits of the new system to be described later on, perhaps it would not be thought inappropriate to enlarge upon the reasons which led up to its introduction. It first suggested itself in connection with water-gas plants. With these plants, engineers have decided that it is absolutely requisite that there should be a special measuring arrangement, entirely independent of the meter as used with the ordinary plants. Now the great disproportion in the size, cost, and space occupied by an ordinary meter in relation to the size of a complete water-gas plant made it at once evident that there was great scope for improvement in this direction. Hence the innovation.

During the past few decades, a revolution has taken place, as all will admit, in almost every department of gas manufacture, as also in its distribution and in its use for lighting, heating, and power. Even the methods of sale have been modified—to the slot system. New methods of carbonizing are now in vogue, distribution is carried on under changed conditions, high-pressure lighting has made enormous strides, and the use of gas for heating and power has become almost universal; while in respect to legislation, a notable restriction, which has hitherto considerably hampered the gas industry, has in at least one instance been placed on one side—I allude to the clause as to illuminating power—all going to show that "old times are changed."

The early pioneers of gas measurement—Clegg, Richards, and others—sufficiently met the requirements of their day, and few attempts have since been made in the direction of change. But to meet the altered circumstances that have arisen, a long series of experiments was entered upon; and the outcome is the "Rotary" meter, which, I believe, will be found an almost ideal measuring apparatus, seeing that it is at the same time small in size and most accurate in measurement. This being proved, it was at once evident that the meter could be applied with advantage in many positions where the ordinary system of measurement was entirely impracticable. For instance, let us take carbonizing as the initial point in our consideration of the question. This new system is applicable to the measurement of foul gas; and I need not dilate upon what this means in the way of furthering your efforts to obtain the greatest yield from your coal.

In a large works the various retort-houses can be sectionalized, and the superintendent can satisfy himself as to the relative merits of the various descriptions of settings, in addition to having the means of checking his daily returns and make. In small works, one or more beds of retorts can be sectional and utilized as a most efficient coal-testing plant; the results having the advantage of being arrived at under ordinary working conditions—a point appealing to all gas managers. It may be urged that hot foul gas will appreciably affect the working of any apparatus through which it passes. Now in designing the new meter for this particular purpose, this fact has not been lost sight of; and the construction is such that every part can be periodically examined and cleansed with the greatest readiness.

It is obvious that the new meter lends itself particularly to sectionalizing in distribution; and as the application of a meter for this purpose is believed to be novel, it may not be out of place to say that in fixing the apparatus no special valves or bye-passes are required, and that the working parts may be easily removed without interfering with the gas supply. Again, although you are not actively engaged in the manufacture of pure and simple fuel gas—I refer to Mond, Wilson, and other producer gases—yet you are greatly interested in them as possible competitors; and in this respect I would mention that the new system will, in all probability, be a welcome addition to their distributing plant, as in their case the size of ordinary meters suitable for dealing with the tremendous volumes they desire to deal with would be out of all character, and could not be entertained. Before leaving this subject of water gas, I would add that it is absolutely requisite that gas authorities should prepare themselves for a conflict as to supremacy in the field of power supply; and I would venture to suggest that time

should be taken by the forelock and efforts made to forstall those competitors by introducing a system of differential rates—advantage being given to consumers of gas for power and trade purposes.

I consider that Mr. Dugald Clerk, in his most interesting paper, has furnished data making a very strong case in favour of differential prices—a debated question. In the discussion which followed, I understood Mr. Clerk to state that even with coal gas of (say) 15-candle power, sold at 1s. per 1000 cubic feet, steam-engines would still be relatively cheaper, as regards fuel, than gas-engines. Now in stating this, it is distinctly understood that he was referring to high-power gas-engines in relation to high-power steam-engines (say) of 100-horse power and upwards. I take it, however, that the greatest revenue, as far as gas companies are concerned, may be looked for from gas-engines up to (say) 50-horse power. Then we come to a very different result as regards the relative efficiency of gas-engines and steam-engines as in general use. Only a few years ago, if my memory serves me faithfully, Sir Frederick Bramwell in referring to tests made of the efficiency of small-power steam-engines, stated that in a large town where a considerable number of engines had been tested, he found that the average consumption was about 9 lbs. of coal per horse power. The worst example was a consumption of about 18 lbs. per horse power. Now with such figures as these, I think you will find that gas at an even considerably higher price than 1s. per 1000 cubic feet would be cheaper than this type of steam-engine. Of course, these steam-engines were not of the compound condensing type now common where large-power engines are used, and where the consumption of coal is reduced to at least one-third of the amount used by the small type of engine referred to.

Again, in reference to your competitors, the electric motor has come into serious competition with small gas-engines. The small size and low cost of the new meter render it particularly applicable in connection with measurement for differential purposes; and I am assured by gas-engine makers that differential rates in favour of power would enable them to resist the onslaught of these motors, and that the use of gas-engines would increase by leaps and bounds. However, a modified form of the meter is necessary where the gas is used direct from the main, and not passed through any other meter. In explanation of this, I must say that, in the station-meter type, smaller quantities than 3 per cent. of the maximum capacity are not accurately measured.

Perhaps the most far-reaching change which has taken place in gas distribution is that recently made by several eminent engineers—viz., the supply of gas at a pressure considerably higher than that required for ordinary use. The object of this innovation is to obviate the necessity of relaying mains, with all the attendant drawbacks attached thereto. I need not suggest to members of this Institute, who are alive to any new outlet for their commodity, that gas at high pressure may be expected in the near future to be demanded for many purposes other than the one mentioned. High-power lighting and furnace requirements are sufficient to demonstrate what I mean; and the supply of this high-pressure gas may be relied upon to foster and increase the sale of your commodity in many new fields, which cannot even be attempted at the present moment. Here, again, the new system of measuring is of service, as it is equally accurate under both low and high pressure.

Throughout the country there are thousands of large meters used for the purpose of measuring the supply to consumers—meters that have in many cases been working continuously and without check as to accuracy for varying periods of service; and these meters are a serious factor to reckon with when considering the question of unaccounted-for gas. This system is applicable for testing and verifying them *in situ*, as a small test meter, made as described, would be readily handled and inexpensively fitted. I have no doubt this system will bring prominently to the front the question of gas measurement and prove of great utility where space is an object, or where the positions are not readily accessible to ordinary meters.

The inventor of the meter, Mr. Thorp—to whom I am largely indebted for his assistance in the diagrams and description of same—does not contend that the principle upon which the new system of measurement is based is novel. Windmills and the like have been used from time immemorial. But what he does contend is that no system based on this principle has been devised for gas measurement.

Anemometers, as you are all aware, are in constant use for arriving at the approximate speed of the wind, and for draughts, &c., but not for actual and accurate measurement. For this purpose, much more is necessary than simply to place a number of vanes in the interior of a pipe and attach to the shaft some form of counting mechanism. The gas must first be guided on to the vanes, so that, whether the flow be small or great, the current passing is distributed in a predetermined manner. Friction must be reduced to a minimum, which can only be done by having the shaft vertical, and using the most refractory substances for the bearings. Even when this is done, it will be found that the indications do not correspond exactly with the flow, except when dealing with comparatively large quantities—the percentage of error gradually increasing as the flow decreases. Therefore, some auxiliary means must be employed to secure accurate measurement for small quantities.

Again, it is very essential that in such a system, the working parts should be so arranged as to be capable of easy inspection, and, if necessary, of being replaced by other and similar parts. All these points have been considered and met in the "Rotary" meter. Neither difference of specific gravity nor pressure within wide limits affects the accurate working of this meter.

Unlike the ordinary turbine, of which the windmill is but a variety, which is designed to utilize the momentum of the fluid to overcome the resistance of the load, the vanes of the new meter, which is practically frictionless and thus absorbs no energy, are set in such a manner that they have no effect upon the current flowing past them. Perfect regularity is thus obtained with all fluids and at all speeds above the minimum, whatever their densities may be.

In the case where the gas is under pressure, however, whatever class of meter is used, allowance will have to be made for the decrease in volume due to the pressure.

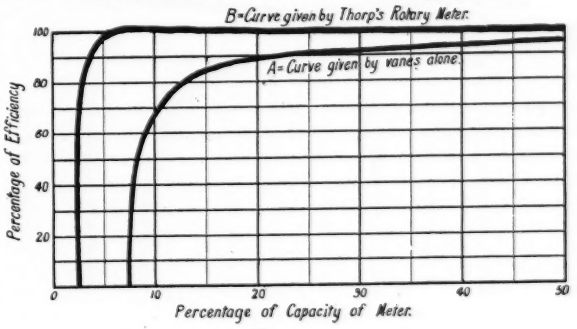


FIG. 1.

Fig. 1 shows clearly the relative accuracy and efficiency of measurement, the horizontal distances being percentages of the capacity of the meter, and the verticals the percentage of efficiency. A horizontal line at 100 given by a meter means that it is perfectly accurate for all rates of flow. I need not remark, of course, that the same percentage of error at small percentages of flow are of much less importance than when such errors are at large percentages of flow. The lower curve (A) is that obtained from vanes attached to a central vertical spindle, but without guides or other auxiliaries; while the upper one (B) is that obtained from the complete rotary meter. The difference is very marked, and shows that for all quantities above about 5 per cent. of the capacity of the meter, the registration is correct within a very small percentage; the capacity percentage varying, as may be expected, somewhat according to the size. The larger the meter, the smaller the percentage below which it ceases to measure correctly.

Fig. 2 shows a sectional elevation of one form of the new meter; the arrows indicating the course taken by the gas in passing through it. A is a guided valve, rising at from 1-10th to 2-10ths pressure. When a small quantity of gas is passing, the valve acts as a spreader, and directs the current into the annular space B, whence it is again directed, by one or more holes, through a flange at the top on to the vanes C, and serves to overcome the inertia of the vanes, &c., and so render them particularly sensitive to the main flow. In order to properly distribute the main flow, the baffle plate D, or its equivalent, is placed between the valve and the guides E, which latter serve to direct the current, so as to give uniform results.

As will be seen, one has only to remove the index cover in order to get at the working parts of the meter, which can

be readily removed *en bloc* for cleansing, &c., whenever required. The pivoting of the vanes has received the most careful attention; and it has been found that by using one of the hardest jewels, resting on a very hard metal point, not the slightest perceptible wear has taken place, even after several months of constant running.

It will probably be urged that gas cannot be sold through this meter, as although it correctly registers small quantities passing through it, it does not register when infinitesimal quantities are passing, and that therefore the meter will be of restricted application. As to this point, I think I have shown sufficient scope for the meter in other directions.

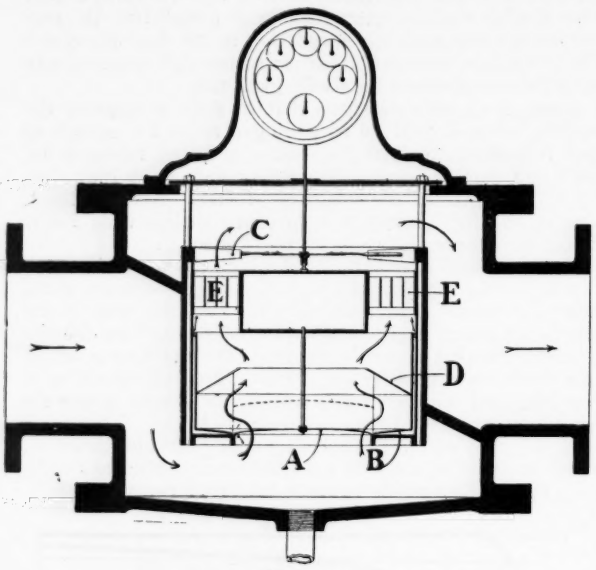


FIG. 2.

But even this difficulty is being met, as at the present moment an automatic device is being added, whereby, when the flow of gas falls below the percentage limit of accurate registration, it ceases altogether, and no gas will therefore pass without affecting the index of the meter. The only possible objection to this arrangement is that it cannot be started automatically, as at least no device has as yet occurred to the inventor for arriving at this certainly to be desired result. The trouble of actuating a lever is, however, not a very great one; and it may actually be found that this arrangement has advantages from another standpoint, which I need scarcely mention here.

Discussion.

Mr. J. P. LEATHER (Burnley) asked what back-pressure Mr. Marsh expected the meter to work at to its full capacity. He should think it must work to at least 2-10ths back-pressure.

Mr. JOHN WEST (Manchester) said this was rather a valuable invention; but, of course, it depended altogether on the accuracy of the measurements. They were informed, however, that it was a positive and accurate measurer. The author said: "This new system is applicable to the measurement of foul gas; and I need not dilate upon what this means in the way of furthering your efforts to obtain the greatest yield from your coal." He assumed that Mr. Marsh had thought the matter out, and that he meant the gas should be corrected for temperature and pressure. This, of course, was unpurified gas. There was once an old Jew who said he wanted his exact pound of flesh, but not one drop of blood. On the same principle, if they measured the foul gas, he presumed they must take the pressure and temperature into consideration.

Mr. ISAAC CARR (Widnes) asked if the author had made any experiments in the testing of foul gas, because it appeared to him there would be some considerable deposit of tar on the vanes of the turbine, in which case registration must be interfered with. He thought there was a field of utility for an apparatus of this description which had not been referred to. They had been discussing the sale of gas for power purposes; and while at the present time few companies had differential charges, doubtless the opposition of power gas would bring that system much more into vogue, and then some such appliance as this would, to his mind, be of use in premises for sub-dividing the gas to be charged at the various rates. For this purpose, it would probably be sufficiently accurate. Of course, an inferential apparatus such as this would never be passed by the Board of Trade for actual registration for the purpose of charge. But it would probably be quite accurate enough for sub-division after the gas had once passed through the meter proper; and it might effect a considerable saving in the cost of supply on that account.

Mr. W. W. HUTCHINSON (Barnsley) said the members were to be congratulated on having had put before them a paper of this kind, which so well described Mr. Thorp's invention. He could quite see that it was a meter which would give to gas suppliers the power of very largely reducing leakage by applying it in a sectional way for obtaining records. With regard to Mr. Carr's remarks, he also thought there would be some little difficulty in getting the meter stamped by Government, unless the difficulty of registering correctly a small flow could be overcome. At the same time, it might be very useful. He was pleased with the ingenuity of the inventor. The principle of the thing they all knew; but he had never before this seen it applied to the measurement of gas.

Mr. G. R. HISLOP (Paisley) thought it was quite obvious that this instrument would be valuable for the measurement of unpurified gas. In making purely illuminating oil gas of 50 or 60 candle power, he had experienced the difficulty of getting it measured. The idea of putting up a large meter of the ordinary make for this purpose, he could not entertain; and he naturally set to work to devise something like this. He had a model at his place, made some four or five years ago to overcome the difficulty; but the parties who were to construct it declared that it could not be done. Among a multiplicity of other matters, it was allowed to fall into abeyance. He was, however, exceedingly pleased to find that the idea had at length been accomplished. In his case, it would be very useful, because instead of having to go to the gasholder to see the quantity of gas made in a run of hours, here they had an appliance with which they could do it on the spot. In water-gas practice, the gas, after it was cooled, could be sent into the gasholder; and, the percentage of carbonic acid or sulphuretted hydrogen being known, it could always be deducted, and the exact volume of purified gas calculated. He therefore maintained that the meter would be valuable for impure gas, even more than for purified gas, or for the differential system.

Mr. C. S. ELLERY (Bath), after thanking Mr. Thorp for the work that he had done, said he rather thought Mr. Marsh might have gone a little further than he had done. In addition to the purposes mentioned, it appeared to him there were uses to which the meter could be put until the time arrived when it might become a stamped instrument, having been made quite perfect. In large hotels and many other places, he took it that gas-fires were not put in the bedrooms because of the difficulty of arriving at a fair charge; but he could conceive that a small instrument of this sort would be very useful for fixing to gas-fires to ascertain the approximate consumption for the purpose of making a charge. The same would apply to cooking-stoves, geysers, and other appliances, which could not be used in many cases on account of the difficulty in making a charge for them in public establishments. With regard to the measurement of foul gas, he hoped Mr. Marsh would make some experiments, and gas engineers would be interested in hearing later on what the actual experience was. But it seemed to him that the vanes were so fine that there would be a difficulty with the tar held in suspension in the gas.

Mr. MARSH, in reply, said the discussion was very useful in enabling him to feel the pulse of the profession as to what was absolutely required. It was necessary for inventors and manufacturers to know the requirements of engineers, in order to be able to cater for them. Very frequently the former had not that knowledge, and simply attended to their own particular branch of the business, without knowing very much in connection with the profession to which they were allied. This was a mistake; but matters were gradually changing, as technical education gave general knowledge more freely. With regard to Mr. Leather's question, the meter would work at a less pressure than any ordinary station meter. It could be made, if requisite, to work at a pressure of 1-10th of an inch, and there were very few station meters which would do that. They might do so at the commencement of their working, but not afterwards. This meter, however, would answer all purposes if it worked

at 2-10ths; and he therefore put it that it would commence at 2-10ths, and measure accurately at any pressure sent through it from 2-10ths up to 50 lbs. He was glad that Mr. West had mentioned the matter of temperature and pressure in connection with the measurement of foul gas. Of course, it would be absolutely necessary, if they wished the measurement to be correct, to take the temperature while the gas was going in, and also the pressure. He might take the opportunity of saying there was one point in connection with pressure which he believed had escaped observation generally by gas engineers. Although he had been engaged in the gas profession longer than he cared to remember, he had never thought about it until making some experiments, when he had some little percentage difficulties. On consideration, it struck him that no meter of any kind would measure the same under varying pressures. Take a station meter working at a pressure of 4 inches, and tested under ordinary atmospheric pressure, and then a second meter working at a back-pressure of 8 inches. Atmospheric pressure was practically about 408 inches of water. Therefore, if they had a back-pressure on the station meter of 4 inches, the gas in the meter was compressed almost 1 per cent.; and so the meter was 1 per cent. slow. But if they had a back-pressure of 8 inches, the meter would be 2 per cent. slow. Therefore two engineers might be getting absolutely the same results from their coal; but, by working at different pressure on the station meter, one would appear to have a better result than the other. On the other hand, in the distribution, the case was reversed; and the other man would then show the best, because the gas would naturally expand again. With regard to Mr. Carr's and Mr. Hislop's remarks as to deposits, there had not yet been any experience of continuous working with foul gas for any length of time; but there had been with ordinary gas and with blue water gas. He did not for a single moment expect that a meter used for measuring crude gas would be kept constantly going without cleaning. As to the size of the meter, it might always be considered as being double the diameter of the pipe; so that if they had a meter on a 12-inch pipe it would be 24 inches diameter. Reverting to the question of cleaning, and illustrating his remarks by a 24-inch meter, he showed that all a man had to do was to take out a dozen bolts, lift out the inside, and, if he had a spare clean inside, drop it in. If he had not a clean one, any deposits that might be on the vanes, or anything of that kind, could be removed from the interior taken out by dipping it in a solution made for the purpose. With regard to differential rates for gas, he was quite at one with Mr. Carr. It would become absolutely necessary, in view of the competition of power gas, to sell gas at differential rates, although there were no doubt difficulties in the way. The electricians were selling in some towns at three rates; but if gas suppliers sold at two rates, they would have an increased consumption, and the capital account would not increase in anything like the same ratio. Take the case of a 12-horse power gas-engine, one of the smallest forms of the "Rotary" meter was amply large enough to measure the gas consumed. All that would have to be done was to break the gas-pipe after it left the ordinary meter, and insert the new meter. The man who owned the engine would then be able to see how it worked—if it were operating satisfactorily; and how much gas was used for power out of the total quantity charged for. If, just for the sake of example, the master meter passed 100 feet, and the rotary meter 20 feet, they would simply charge 80 feet at the ordinary rate, and 20 feet at the discount rate. Mr. Hutchinson's question was very pertinent as to the sale of gas by this meter. In the paper, he had simply touched on entirely different channels, in which meters had not been actually used. He had not yet had time to go into the question of the Sales of Gas Act; and really he did not want in any way to interfere as yet with the smaller type of meters. But, as he had foreshadowed, as far as measurement for power purposes was concerned, it would, he believed, eventually be attempted, if they got sufficient support (and in these red-tape matters they must have support), to have them stamped. Any objection would be easily met in this manner: The meter did not commence registering correctly until 5 cubic feet an hour was passed through it, and he should arrange it so that nothing less than 5 feet could go through. It would commence measuring then; and up to 200 feet an hour it would be correct. If they supplied a man with gas at less than the ordinary price, they might say to him: For anything you use above 5 feet for power purposes, we shall make a deduction of so much per cent. But if you only want 5 feet an hour, we are not going to make any deduction." Therefore, if a smaller quantity was passed, it would go through the ordinary meter, and be charged for in the ordinary way. These were all things which engineers would know how to deal with better than he did. The President had just asked him what was the relative cost of this type of meter and an ordinary station meter. The sale price—that which it would cost gas engineers—would be one-half the price of the ordinary station meter; but, of course, this was a very small matter in comparison with the other savings. A meter to do the same work as the one he had on the table before him would require a house, at any rate, 10 feet square, which would cost considerably more than the meter itself. But for this one, a rabbit-hutch would be quite sufficient.

The PRESIDENT said, at the Southampton Gas-Works, they were working under some disadvantages at present for want of a station meter to measure the carburetted water gas; but he could not introduce one for the simple reason that they had no place to put it. Perhaps this apparatus might come to their aid.

EFFICIENCY AND ECONOMY IN GAS DISTRIBUTION.

By WALTER HOLE, of Leeds.

In preparing this paper for our meetings, I recognize that membership of the Institute has its duties as well as its privileges—responsibilities as well as pleasures. If the Institute is to attain to its fullest measure of usefulness, each member, even down to the humblest, must be willing to put his ideas, practices, and experience into the "common stock," even though he may not be a master in the field of original research, or have anything revolutionary to communicate. Simple loyalty to the Institute demands so much; and it is in that spirit alone that I consented to write this paper.

The term "gas distribution" is such a comprehensive one, covering as it does the whole field from the gasholder to the point of combustion, that I propose to restrict myself to that part of it which most concerns and interests those who are responsible for the actual distribution of gas from the works to the consumers. I therefore, at the start, rule out all those most interesting and attractive questions which are receiving so much attention just now, and which have to do with the consumption of gas after it passes the meter.

The cry of the time is all for "efficiency." This is written in good, bold characters at the top of every self-respecting person's slate nowadays. If I may apply this word to the subject in hand, I would say that efficient distribution implies three things, commonplace enough in themselves, but in their working out requiring the most constant care and attention—

I.—The ensuring of an adequate and full supply of gas to each individual consumer.

II.—The maintenance of the distributory system in a sound condition, and the lowering to a minimum of leakage due to concurrent working.

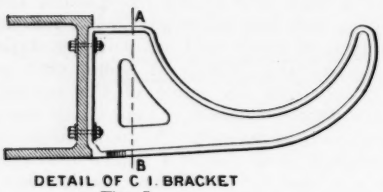
III.—The planning of all new work with a view to possible future requirements (due regard being had to economy in capital expenditure) rather than the hand-to-mouth policy of merely meeting the bare necessities of the present.

The enormous development of the use of gas for cooking, heating, and power during the last decade, and the consequent necessity of maintaining during the whole day and over the whole lighting district, of a sufficiency of gas at good pressures, and the increased consumption per mile of main on the one hand, and the tremendous growth during that time of some of our large towns and cities upon the other, have clothed the problems of gas distribution with an interest and complexity which demand the highest intelligence and untiring industry for their correct solution. The city of Leeds, with its great industrial and mercantile interests, is a good illustration in point. It needs no apology, therefore—indeed, it will probably be much more agreeable to you—if I should leave the vaguely general and deal for a minute or two with the particular city with which I am connected. The following table shows at a glance the developments there:—

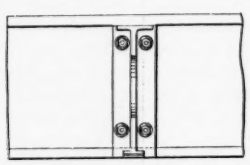
Gas Made.

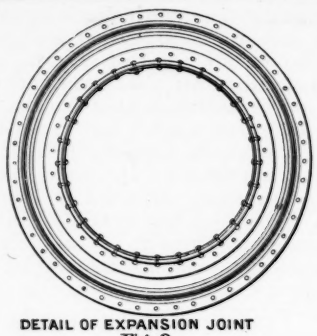
In 1891	2,411,931,900	cubic feet
,, 1901	3,140,870,690	,, ,,

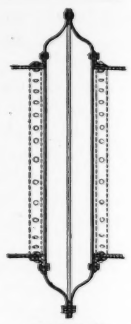
Increase, 30·2 per cent.



DETAIL OF C I. BRACKET
Fig. 1


SECTION ON LINE A.B.
Fig. 2.


DETAIL OF EXPANSION JOINT
Fig 3.


SECTION.
Fig.4.

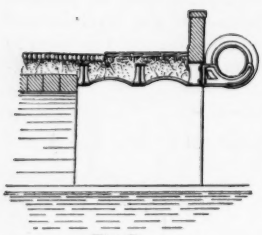


Fig.5.
CROSS SECTION OF PARAPET.

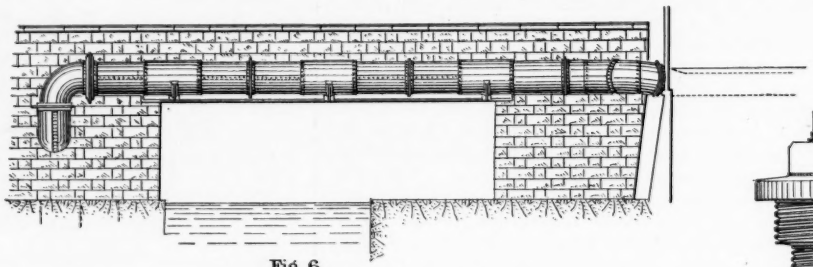


Fig.6.
FRONT ELEVATION

EXPLODER.
Fig.18.

Fig.19.

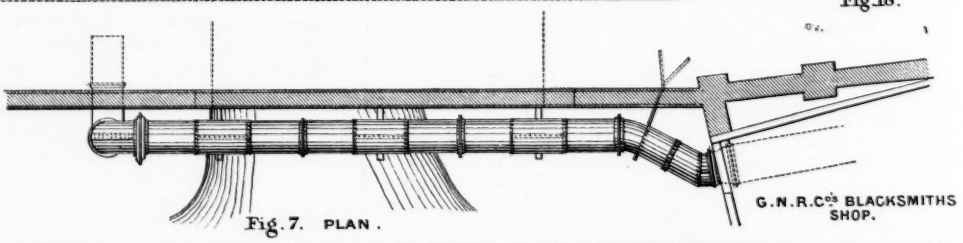


Fig.7. PLAN.

Gas Sold.

In 1891 . . . . . 2,132,468,600 cubic feet
,, 1901 . . . . . 2,838,417,200 ,, ,
Increase, 33·1 per cent.

Length of Mains.

In 1891 . . . . . 700 miles
,, 1901 . . . . . 855 ,,
Increase, 22·1 per cent.

Gas Sold per Mile of Main.

In 1891 . . . . . 3,046,383 cubic feet
,, 1901 . . . . . 3,319,786 ,, ,,
Increase, nearly 9 per cent.

Twenty-Four Hour Maximum Consumption.

In 1891 . . . . . 14,139,500 cubic feet
,, 1901 . . . . . 16,900,026 ,, ,,
Increase, 19·5 per cent.

Meters, Stoves, and Gas-Engines.

Year.	Meters.	Stoves.	Gas-Engines.
1891	82,195	1,105	325
1901	100,649	9,814	975
Increase per cent. .	22·4	788	200

City of Leeds Trunk-Mains Extension.

The trunk mains having by that time become greatly overworked, the writer was instructed in 1898 to prepare a scheme by which the distributing system should not only be brought abreast of the then present demand, but which should also make suitable provision for probable future requirements. That scheme, which was adopted in its entirety by the Gas Committee and the City Council, arranged for the completion of the work suggested within the period of five years.

Acting on the well-known principle that trunk mains should be as few in number and as large in diameter as possible, so as to obtain the greatest efficiency, with economy in weight of metal, and the least friction, a general rearrangement and enlargement of the trunk-main system of the city was decided upon, the details of which it is unnecessary for me to enlarge upon here.

Thirty-Six Inch Main in Wellington Road.—As the obstacles encountered in the laying down of one of these mains led to features of a rather interesting character, will you allow me to amplify a short sketch which appeared some months ago in the "Gas World." I pass by the more ordinary difficulties—tunneling under tram-lines, crossing lines of water-mains and sewers, which necessitated the carrying of the main down in places to a depth of over 10 feet, and the continual use of pumps by night and day, and come to the first great obstacle—viz., the Leeds and Liverpool Canal, and the second immediately following it—the subway of the Great Northern Railway Company connecting their goods-yard with the main line, both of which at this point cross under the roadway at right angles to it. The canal bridge was at one time only half its present width; the original portion being of low, old-fashioned stone arch construction, which was extended by iron girders carrying the additional width of roadway from the stone buttresses. These girders are 2 feet deep and are spaced 3 feet apart, centre to centre, as shown in fig. 5. There was, therefore, no sufficiency of cover to bury the 36-inch main either in the footpath or roadway, even had the way been quite clear. As a matter of fact, however, there were already two 20-inch mains in position there, neither of which could be dispensed with. The road over the subway is carried by similar girders, spaced in the same manner; and the depth of the subway is just sufficient to allow for the chimneys of the railway engines to clear the bottom flanges of the girders. In the goods yard adjoining the road, the girders over the subway were found to be spaced much wider apart; and arrangements were therefore made with the Canal and Railway Companies to carry the main over their properties.

Steel Main over the Canal.—The main over the canal (shown in fig. 6) was of circular section, 36 inches diameter, of plain steel riveted pipes, $\frac{3}{8}$-inch thick. The longitudinal and transverse seams are ordinary lap single riveted with $\frac{3}{4}$-inch rivets at 2 inches pitch. Both ends of the pipe have solid welded rings of steel angle 3 in. by 3 in. by $\frac{1}{2}$ in., riveted on with $\frac{3}{4}$-rivets at 2 inch pitch. The flanges were all machined true, and had each 28 bolt holes of $\frac{7}{8}$-inch diameter. The whole of this section is carried on three cast-iron brackets, as shown in figs. 1, 2, and 3. The expansion joints adopted are shown in figs. 3 and 4, and were made of $\frac{3}{16}$-inch steel disc

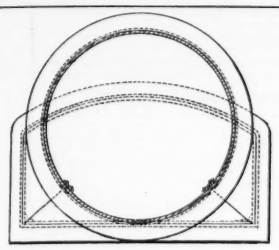


Fig. 8. DETAIL OF END CONNECTIONS AT C.

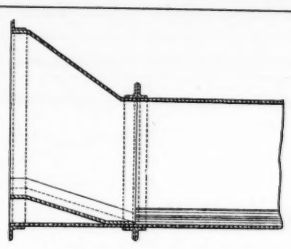
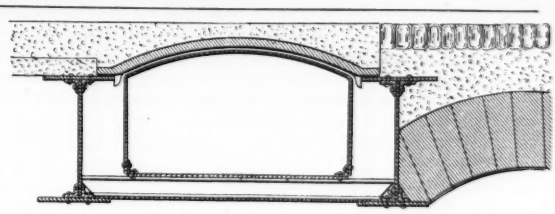
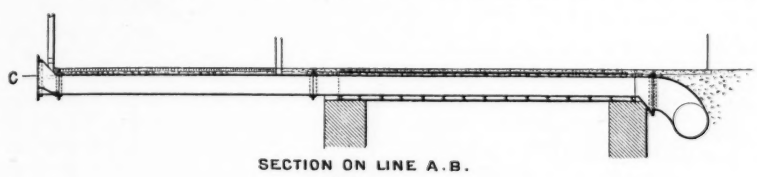


Fig. 9.



CROSS SECTION.
Fig. 10.



SECTION ON LINE A.B.
Fig. 11.

END PLATE.

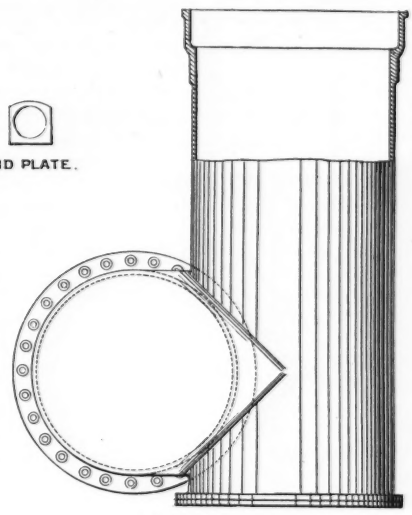
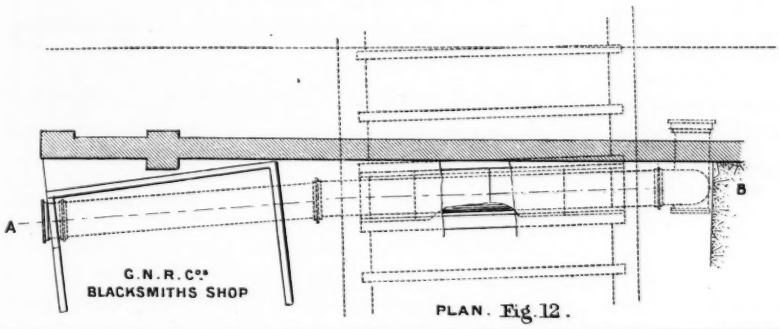


Fig. 13.



PLAN. Fig. 12.

plate 4 ft. 10 in. in diameter; the flanges stiffened by 3 in. by ½ in. steel rings.

Steel ⊓ Main through the Railway Company's Premises.—Reference to figs. 11 and 12 will make clear the plan of the main running through the Great Northern Railway Company's premises. In entering the goods yard from the Canal Company's towing path, it was necessary to accommodate the section of the main to the space available between the girders. A jack arch between two of the girders was removed to make room for the new main, which here took the ⊓ section shown in fig. 10.

The main, which is made in one length of 32 feet, is carried on sixteen light steel joists 3½ in. by 3½ in. placed 24 inches apart, which serve also to take the thrust of the girders. The main is protected underneath by iron plates ¼-inch thick, upon which the steel joists rest, and at the top by the cast-iron plate, slightly arched, of 1¼ inches thickness, with lugs cast on take the top thrust of the girders, as shown in fig. 10. The whole space between the girders and main was afterwards, at the request of the Railway Company, filled in solid with concrete. The connecting pieces from the circular to ⊓ section are shown in figs. 8 and 9.

Steel Main over the River Aire.—The next great obstacle encountered was the bridge over the River Aire, which in Wellington Road is of a massive stone single arch construction. Here again, there was not sufficient cover to the bridge arch, either in the roadway or footpath, to contain the proposed main, and no room horizontally to lay in pipes of eccentric section. There was no alternative to going outside once more, and supporting a few lengths of steel main from the parapet of the bridge. This main, as shown in figs. 14 and 16, is of similar section, strength, and build to that over the canal; but in this case, it is supported by six wrought iron brackets of 4 inch by 2 inch section, forked as shown in figs. 15 and 16 with suspenders. The forked end under the footpath was embedded in concrete.

Economy of Using Longer Pipes.

If efficiency, in one aspect of it, consists in obtaining the maximum of result with the minimum of expenditure, a move in the right direction has recently been made by manufacturers in arranging to cast pipes in longer lengths. It may not be generally known that all sizes of pipes from 4 inches and upwards are now obtainable in 12-feet lengths, whereas formerly 3-inch to 10-inch were only obtainable in lengths of 9 feet. This may seem a small matter: but a simple arithmetical calculation will show you that it really ensures a very considerable economy in main-laying.

Here is a factor of economy which has been all too long neglected. The saving in weight of pipes alone is considerable. Take 1000 yards of 4-inch main as a suitable unit for purposes of comparison. The total weight of 1000 yards run of 4-inch main in 9-feet lengths is 27 tons 19 cwt. 1 qr. 24 lbs. But the total weight of 1000 yards of the same size of main in 12-feet lengths is 27 tons 5 cwt. 2 qrs. 4 lbs. —a difference of 13 cwt. 3 qrs. 20 lbs., due to there being 333 sockets in the one case and only 250 in the other. Then economy in the mere weight of metal is, of course, only part of the saving effected. Eighty-three less sockets means an equivalent reduction in the matter of lead, yarn, and labour for jointing and excavation. All these together go to make up a very respectable sum saved per 1000 yards of main laid, as will be seen by a glance at the following bill of costs:—

Material.—13 cwts. 3 qrs. 20 lbs. 4-inch mains at 5s. 6d. . .	=	£3	16 7
83 joints, at 4 lbs. each, = 3 cwt. of lead, at 14s. 6d. . .	=	2	3 6
83 ,, ,, ,, = ¼ ,, yarn, at 13s. . . .	=	0	3 3
Labour.—Jointer's Time: 83 × ½ hour = 42 hours at 6¾d. .	=	1	3 7½
Labourer's Time: Excavating 83 × ½ hour = 28 hours at 6½	=	0	14 7
Total amount saved . . .		£8	1 6½

As we proceed upwards in the scale, the economy progressively increases, as will be seen by the subjoined table showing saving effected in 6-inch and 8-inch mains.

Economy Effected by Using Pipes of 12-feet Lengths as Compared with 9-feet Lengths.

Size of Main.	Value of Iron saved per 1000 Yards run.			Value of Material saved per 1000 Yards run.			Value of Labour saved per 1000 Yards run.			Total per 1000 Yards run.		
	Weight.			Material.			Class.					
	Tons. Cwt. Qrs. Lbs.	£	s. d.		£	s. d.		£	s. d.	£	s. d.	
Inches.												
4	0 13 3 20	3	16 7	Lead	2	3 6	Jointer	1	3 7½			
				Yarn		3 3	Labourer	0	14 7			
		3	16 7		2	6 9		1	18 2½	8	1	6½
6	1 2 0 9	5	18 8	Lead	3	15 2½	Jointer	1	7 3½			
				Yarn	0	4 10	Labourer	1	1 10½			
		5	18 8		4	0 0½		2	9 2	12	7	10½
8	1 11 0 14	8	3 5	Lead	5	7 5	Jointer	1	11 0			
				Yarn	0	6 6	Labourer	1	5 3			
		8	3 5		5	13 11		2	16 3	16	13	7

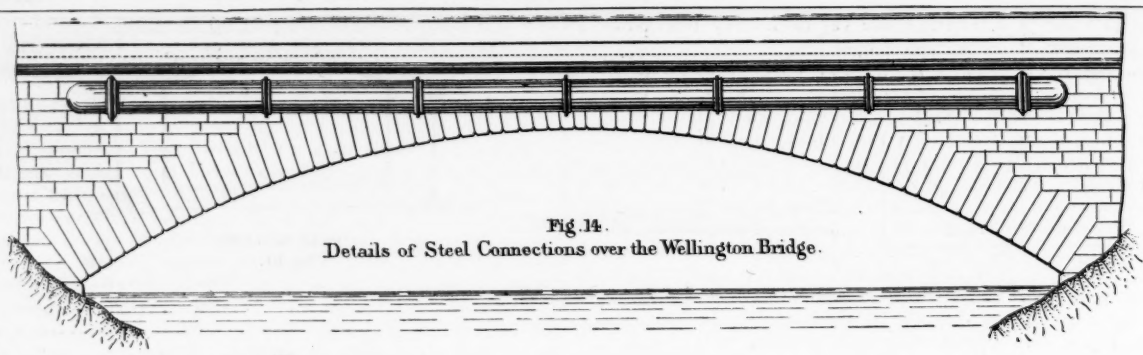


Fig. 14.
Details of Steel Connections over the Wellington Bridge.

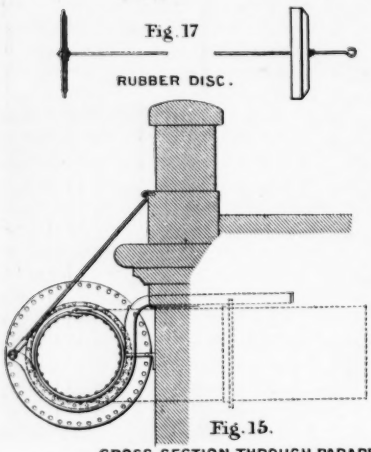


Fig. 15.
CROSS SECTION THROUGH PARAPET.

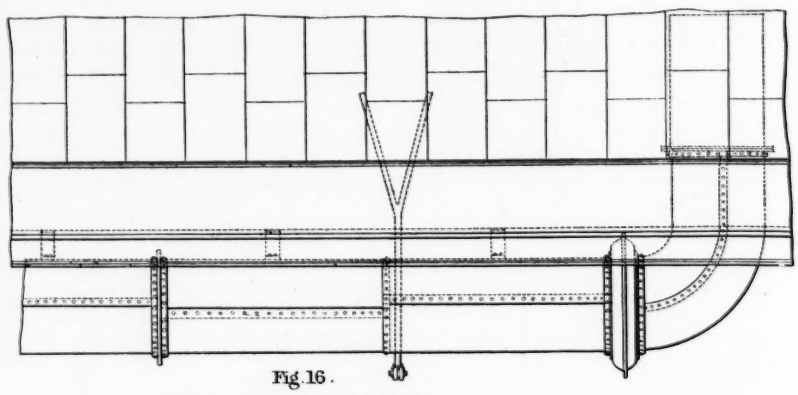


Fig. 16.
PLAN OF ONE LENGTH AND BEND

Extension of the Same Principle.—Why stop here? There is no sufficient reason why pipes of 12 inches diameter and upwards should not be cast in 15-feet instead of 12-feet lengths as at present. I am informed by one of the principal firms of pipe-founders that they are quite prepared to make the necessary structural and mechanical alterations should there be a sufficient demand for the longer lengths to warrant them in doing so. A glance at the subjoined table showing economies possible in this direction worked out at per 1000 yards run of three larger sizes of mains, will repay perusal.

Economy Effected by Using Pipes of 15-feet Lengths as Compared with 12-feet Lengths.

Size of Main.	Value of Iron saved per 1000 Yards run.					Value of Material saved per 1000 Yards run.				Value of Labour saved per 1000 Yards run.				Total per 1000 Yards run.		
	Weight.				£ s. d.	Material.	£ s. d.			Class.	£ s. d.			£ s. d.		
Inches.	Tons.	Cwt.	Qrs.	Lbs.												
18	2	18	2	18	13 11 3	Lead	10	7	2	Jointer	1	17	8			
						Yarn	0	8	9	Labourer	1	14	11			
					13 11 3		10	15	11		3	12	7	27	19	9
24	4	12	1	3	21 6 9	Lead	15	10	8	Jointers	4	4	5			
						Yarn	0	11	7	Labourers	2	12	1			
					21 6 9		16	2	3		6	16	6	44	5	6
30	6	18	1	16	32 0 0	Lead	19	8	5	Jointers	5	12	6			
						Yarn	0	14	6	Labourers	3	18	1½			
					32 0 0		20	2	11		9	10	7½	61	13	6½

Objections Considered.—The only objection there can be to this suggestion is that, by increasing the length of each pipe, the elasticity of the main, and its power to accommodate itself to subsidence of the subsoil, becomes slightly reduced. Against this, we have to set the fact that small mains are now generally laid under the footpath, and are therefore not subject to either the crushing weight of, or the vibration inseparable from, the heavy traffic of the roadway. The larger mains, necessarily laid in roadways, are now placed at a much greater depth than formerly; and usually upon either a good natural bottom, or one specially prepared. It is usual, too, nowadays, for roadways subject to heavy traffic to be concreted under the paving; and this, by spreading the load, protects the mains in the subsoil proportionately. It must also be borne in mind that the fewer the joints the fewer the possible sources of leakage.

Economy Through Laying Several Instead of Single Pipes.—In laying mains, instead of laying the pipes singly, it is preferable to excavate a length of trench, and then joint three of the pipes upon cross battens above ground and over the trench, before they are lowered into position. The advantages of this method of working are: (1) That two out of three joints are made with plenty of room for working, where they can be easily got at and fully inspected after being set up. All this makes, of course, for the best of workmanship. (2) The excavation necessary for two out of three successive joint holes is saved, and thus a very considerable economy in labour is effected, especially in the case of large mains. This also may seem a very small matter; but a little arithmetic will again show how these many mickles make a very considerable muckle when multiplied out. Taking once more 1000 yards run as our unit, we find the economy for several typical sizes to be as follows:—

	£ s. d.
Economy in excavation per 1000 yards of 4-inch main =	1 18 6½
,, ,, ,, 6 ,, ,,	2 17 9¾
,, ,, ,, 8 ,, ,,	3 7 5
,, ,, ,, 18 ,, ,,	5 16 1¾
,, ,, ,, 24 ,, ,,	8 13 11½
,, ,, ,, 30 ,, ,,	13 0 11¼

The writer had considerable difficulty with the extremely conservative British workman when this system was first introduced into Leeds. He was consequently very much amused the other day to find one mainlayer realizing so much the desirability of working in comfort that he had jointed no less than six 3-inch pipes together before lowering them into the trench.

There is just one precaution which must be observed, however, and that is to see that the pipes are properly balanced in the slings before being lowered into the trench, so that no strain may be put upon the joints.

Antimony Alloy for Jointing.

I suppose that most of the members have been impressed at some time or other with the fact that, although many and varied improvements have been introduced into almost every other branch of work in connection with gas making and distribution, we are still jointing pipes in the same way, and with the same material, as our grandfathers, if not even our great grandfathers, did. It has occurred to the writer that, by making use of an alloy of one of the metals which expand on cooling, a tight joint might be obtained which would dispense with the present cumbrous and expensive method of "setting up;" and thus effect a very considerable economy in labour. He has, therefore, recently been carrying out a series of experiments which, though unsuccessful from the

point of view of economy, have yet been very interesting and successful as technical studies.

For the work on hand, bismuth at half a guinea a pound was, of course, absolutely prohibitive, even if suitable in itself. Alloys of antimony were therefore tried, commencing with a low-grade mixture of that metal, tin, and lead, and in the following proportions: Antimony, 20 per cent.; tin, 10 per cent.; and lead, 70 per cent. Joints made with this alloy were unsound at 3 inches water pressure. Continuing with a gradually increasing proportion of antimony, and continually varying the proportion of the metals through many failures, and more partial successes, complete success was ultimately attained, from the point of view of soundness, with an alloy containing: Antimony, 28 per cent.; and lead, 72 per cent. Joints run with this mixture, at a temperature of 365° C. (hot enough to char to a deep brown a piece of note paper without causing it to light), are perfectly sound up to a pressure of 12 inches head of water, and will stand very considerable deflection without leaking. In a run of five 6-inch pipes, the writer forced the centre down over 7 inches without causing the slightest leakage.

As an extreme test, heavy baulks of timber were dropped upon one of the joints supported only at points 12 feet away from the socket, but without drawing sufficiently to cause it to leak. But although these joints were sound, they were not cheap. It was found that the increased cost of the alloy over that of lead more than swallowed up the saving due to the economy of labour. But while too expensive to use under ordinary working conditions, this alloy may be even cheap where, as frequently happens in laying large mains, or making intricate connections to trunk mains, joints have to be made in almost inaccessible positions, involving considerable delay, a disproportionate expense in excavation, and the workmen labouring in very cramped and awkward positions. In such cases, it may be much more economical to use a metal even at 28s. or 30s. per cwt., rather than face the increased cost of labour.

Rubber Discs.

With a view to avoiding the danger inseparable from the daily bagging off, and also the loss of gas, when laying a straight run of pipes of 6-inch diameter and upwards, the writer has adopted the use of a rubber disc, firmly held between two plates of thin iron and guided by a wooden bobbin (see fig. 17). This arrangement keeps the gas back, avoids danger from men striking a spark, saves cutting of numerous holes for bagging off, saves gas lost in bagging, saves time and labour, wear and tear of bags and tools, is easily manipulated, and incidentally ensures the main being left perfectly clear. When the pipes have been lowered into the trench, and before being placed in position, a rope is threaded through them by which the disc is pulled forward in each section after the joints have been made.

Gas Bags.

The use of gas bags cannot, of course, be dispensed with altogether. Manifestly the discs are useless when making final connections, or turning corners, &c. Bags should be made of best canvas, and all seams stitched. Many accidents have occurred through the rubber solution with which the joints of bags are ordinarily made being dissolved by the condensation in the mains, and causing the bag to burst. Even when stitched, I have frequently found it advisable to use two, and occasionally three, bags on the same end. If any difficulty is found in completely keeping the gas back, moistening the bag with water before using will usually be effective.

Cup Drills.

One of the needs of the engineer has for long been some simple and effective method of tapping mains without the loss of gas inseparable from the present system. This want has been admirably met in the cup-drill-tap arrangement (see fig. 19). The writer has had these drills in use for some seven or eight months now, and has frequently used them on high-pressure mains without any appreciable leakage in drilling and tapping.

Exploders.

For clearing services stopped by corrosion or naphthalene, the writer has found the ingenious arrangement shown in fig. 18 (and which is a modification of one patented years ago by the late Mr. George Goldsmith, of Leicester) for exploding a small charge of gunpowder down the service-pipe very handy and effective. With this simple instrument, one man can do as much work as several with the old-fashioned force pump or digging up the ground—and that, of course, without the slightest leakage. I have one of these exploders with me, and shall be pleased to explain its working to any who may be interested in it.

Subways.

There appears little reason to doubt that the congestion of traffic in the main thoroughfares of our large towns, and the increasing danger both to vehicular and pedestrian traffic involved in a continual breaking up of the roadways for the inevitable renewals, repairs and connections of the various gas and water mains, electric lighting cables, electric tramway cables, telephone, and telegraph cables, will before long lead to a general movement for the construction of subways under the principal streets to accommodate them—especially where main thoroughfares are being widened, or new ones made; and these will probably take the form of one large subway under the centre of the road in some places, and in others—and preferably—two smaller ones, one on either side of the roadway.

The writer recently had occasion to investigate this question, and in connection therewith visited the subways at St. Helens, Lancs., and those in Northumberland Avenue, Shaftesbury Avenue, and Victoria Embankment in London. He found that no trouble had been experienced with leakage due to expansion and contraction, and that services were connected up to the trunk mains direct, and in many cases without cocks. It is, however, deemed necessary that an employee of the gas department should inspect the mains in the subways every day. Arrangements are made with the local authority for immediate entry at any time in case of necessity. In the opinion of the writer, however, it would be a very great improvement on anything he saw in any of the subways mentioned, if, instead of connecting up services direct to trunk mains, and so having to break up the roadway every time a service-pipe needed repair, renewal, or enlarging, or new services needed connecting, the trunk mains in the subways were linked up by transverse feeds at suitable points to a system of distributing mains laid under the footpaths. The advantages would be:

(1) Greater elasticity in details of distribution.
(2) Avoidance of danger from exhaust gas when laying or repairing services.
(3) The services and small mains from which leakage most often occurs would be get-at-able without breaking the roadway between the subways and the buildings.
(4) It would be possible to carry out repairs without cutting off the supply to third parties.

It goes without saying that this arrangement would entail a rather larger initial capital outlay; but the advantages would fully compensate for the increased cost, and it would probably be found the most economical in the long run.

Electrolysis.

In our large towns where electrical traction for tramways is being greatly developed, the prospect of the return currents breaking bounds and detaching themselves from the provision made for their accommodation to roam at their own sweet will through the distributing system of gas and water departments unchecked and undiscovered, travelling sometimes by gas and sometimes by water mains in a most intermittent and perplexing fashion, and giving no sign of their presence until the leakage or fracture of the gas-main or bursting of the water-main presents damning evidence of their malign influence, is enough to fill a distributing engineer with dismay and dread. Even when the presence of the current is detected, it is impossible to locate the exact spot where electrolysis may occur, or in other words, where the current may leave the mains again to travel by its own legitimate route. The fact that "pipes are not continuously perfect conductors, and that thus there is a disposition to jump the joint," destroying the iron wherever it leaves the pipe, is an aggravation of the evil. Electrolytic action may occur within differences of potential of 0·5 volt, but we are told that currents have been known to leave the rails even where the bonding was so perfect as that the difference of potential between successive rails did not exceed 0·003 volt, showing that even "a well bonded track return is no preventive of electrolysis."

We are also told that "it cannot for a moment be contended that the bed of concrete" upon which the rails are usually laid "is an insulator," except perhaps indirectly by preventing surface water percolating through to the subsoil.

The question therefore naturally suggests itself "Can anything be done to avoid the evil?" If it is true, as we are assured by those who have given special attention to this subject, that "the only real remedy is a complete metallic circuit entirely insulated from the earth;" then, in view of the great financial interests and the grave danger to life and property involved (we have recently seen at Bradford what the current is capable of doing with a main under special circumstances), we have a right to ask that no question of expense should be allowed to prevent a satisfactory solution of this difficult problem. First of all we need definite information as to whether our mains are being used as vehicles by wandering currents; and, if so, to what extent. As a first step, would it not be advisable in all cases wherever a main is broken for the purposes of extensions or repairs in proximity to an electric tramway to make a test for the presence of current? A delicate galvanometer would be useful for this purpose. Another and very simple test for the presence of current would be to connect up an ordinary telephone receiver to the severed ends of the main, when, if current is passing, a distinct rumbling or crackling sound will be heard. If these or similar tests were carried out all over the country, and any positive results obtained communicated to the profession at once through the columns of our Technical Journals, we should probably in a comparatively short time be in possession of such a mass of evidence as would enable us to go with confidence to the electrician and say to him: "The evil is undoubtedly present of the existence of which you have hitherto been sceptical. It is now your duty to adopt whatever measures of a preventive character may be necessary to safeguard us against the results which must inevitably follow a continuance of this leakage of yours."

Discussion.

Mr. J. P. Leather (Burnley) said he had had some experience in the laying of large mains within the last three years. He had laid several miles of 30-inch mains through busy streets, and had come across some of the obstacles referred to by Mr. Hole. One point struck him in connection with the way in which he got over the canal and railway bridge, and this was that the companies had objected to some of the things Mr. Hole used. For instance, he went to the railway company and suggested going alongside a bridge of theirs by a riveted steel tube, and showed suspenders similar to those Mr. Hole showed in connection with the bridge over the Aire. But the engineer of the company would not allow either suspenders from the girders or any brackets at the end of the tube on the stone abutments of the bridge. He said the whole thing must be entirely self-supporting. A 30-inch tube of $\frac{3}{8}$ inch steel plate would support itself for a long length; and in one case a 52 feet span had to be used. The same difficulty occurred where they crossed canals. He agreed that 12-feet lengths were some advantage over 9 feet; but he had not yet been able to get 12 feet of the rather smaller sized pipes. When he asked for them, he found he could get the 9-feet lengths quicker. Of course, for all sizes above 10 inches he had been accustomed to use 12-feet lengths for a long time. It was suggested that it was possible to use even longer lengths; but in many instances this could not be done. Only about a week ago they were laying a 30-inch main along a street. First of all, there was a water-pipe, 6 feet from that an electric cable, and then again the Post Office telegraph 6 feet farther on. They could not have a long length of the roadway open there in a very busy portion of the town, so that they had to put in shorter lengths even than 12 feet at that point. Again, with 15-feet lengths in the larger pipes, small curves could not be turned so readily. One side of the pipe was drawn too much out of the socket if the angle was anything greater than about $1\frac{1}{2}°$. He had heard of the disc arrangement, but had not seen it; neither had he conversed with anybody who had used it. But the idea seemed good; and, as Mr. Hole had employed it, he should like to try it. As to electrolysis, Mr. Hole had given them a good suggestion, which he presumed he was going to carry out himself—namely, to take an actual measurement of the difference of potential between the ends of any broken mains when they occurred near electric tramways. In their own case, near the central feeding point of the tram-lines, which did not go actually to the central station in the centre of the town, the gas-mains had been bonded to the rails. They had made a copper connection with a plastic bond on to the gas-main which crossed the tram-rails there, in order to carry out the idea mentioned by Mr. Swinburne, that the current should not pass through the main at that point in such a way as to produce electrolysis. If they had not the metallic connection, the current would possibly leave the main and go to the rail; and in leaving the main it would be pitted and eaten away. The extreme voltage for a distance of some 3 miles from the centre was about 4 volts. He had not measured it personally; but he believed the needle jumped up to show about 7 volts, though it was probably only the jumping of the instrument, and the actual voltage at the commencement of starting the car at the end of the line at 3 miles from the centre was 4 volts. Though with such a length of gas-main there would probably be a very considerable resistance, there might be a great deal of current. He should certainly take an opportunity of making the test suggested; and if Mr. Hole did the same, they might be able to compare results.

Mr. W. W. Hutchinson (Barnsley) inquired if Mr. Hole would put on record the cost of the alterations he had mentioned with reference to the steel main over the canal. Inasmuch as there were many similar cases occurring up and down the country in connection with the introduction of tramways, he thought the information would be of general benefit. With regard to the length of mains, in view of the author's experience, he would ask him what he should recommend in a distinctly all-round mining district—9 feet or 12-feet lengths. Again, as to the damage from electrolysis, could Mr. Hole give any specific cases in his experience at Leeds, and also tell them what precautions he had taken or considered necessary. As members knew, tramways were extensively used in Leeds; and they would like to know what the effect had been.

Alderman Miles (Bolton) said they were familiar with the use of 12-feet mains instead of 9 feet; and he was glad to see Mr. Hole going a little further, and suggesting 15-feet lengths for larger sizes. It occurred to him, however, that in using 15-feet lengths, they would not be able to move them about and treat them so readily and handily as the smaller sized mains; and therefore he had some fear that the labour involved would be considerably heavier. He should like to know if the 15-feet lengths had been brought into actual practice in Leeds in the case of large pipes. Probably at their next annual meeting, Mr. Hole would recommend the use of 18-feet lengths.

Mr. S. Y. Shoubridge (Sydenham) suggested that it might be an advantage, in districts where electrolytic action was to be feared, to carry the author's suggestion a little further, and at suitable places along the gas-mains nearest the tramways have wires attached, which could be brought up to a convenient position, so that an inspector might go along periodically and test with a galvanometer to see what amount of current was passing. In certain conditions, it might be an advantage, in laying mains near the tramways, if they offered a sop in the pan to this cerberus in the shape of putting a sheet of iron some distance above the main, but a short distance below the surface of the ground, so as to induce the stray currents to take their way through the large metal surfaces, instead of through the mains.

Mr. G. R. Hislop (Paisley) said he gathered that Mr. Hole was in the habit of laying mains along footpaths; and he thought this was a very efficient method of supplying gas—a method which he had himself followed for a long time, except in the case of large mains, which were laid along the road as close to the kerb as possible. All the mains of 6, 4, and 3 inches and downwards he laid under the footpath. If this plan were carried out, it would tend to relieve the difficulty and danger which arose from heavy traffic, and would also greatly reduce the length of services and the cost of maintenance. If the services had to be renewed, it was a simple matter to get at the main pipe by lifting a slip of the pavement. This having been his practice for so many years, he could bear testimony to the great importance attached to this method of supplying gas. He agreed with the laying of large mains as near the gutter as possible so as to avoid contact with tramway rails.

The President said he sympathized with Mr. Hole in some of the difficulties that he had to contend with. These occurred in most districts where there was a rapid extension of demand. In Southampton, in going out from the gas-works into the district for some miles all round, there was great trouble in getting the trunk mains away. He had just completed two culverts under five lines of railway; and it had taken three weeks to accomplish. In former days, they could have done it by breaking the Sabbath; but now

special precautions had to be taken to sustain the main lines, so as to allow the traffic to run over them while the men were at work underneath. This was only one of the difficulties found in a rapidly increasing district. In his own area of supply, the difficulties were very much like those experienced at Leeds.

Mr. HOLE, in reply, said this was his first appearance before the Institute as a reader of a paper. He was much obliged for the kind way in which he had been received. In reply to Mr. Leather's question, he saw the engineers of the canal and of the Great Northern Railway Company; and they met him in a very accommodating spirit indeed. He had not the slightest difficulty in this respect. Exception had been taken to using longer lengths of pipes, simply on the ground that occasionally they could not get a long length in. But this was no reason why longer lengths should not be used where possible; and this was the case generally. As far as his own experience went, it was only very rarely the long lengths he suggested could not be used. They were not always going round curves, nor meeting telegraphs, cables, and water-pipes at every few yards. He had, of course, taken his own advice with regard to testing mains for electric current wherever an opportunity occurred—wherever they had broken a main near an electric tramway. But he was bound to say that, with one exception, he had never obtained any definite result. Moreover, in this one case the amount of current was very small indeed. It was just enough to deflect the galvanometer needle, and that was all. He therefore came to the conclusion that it was simply due to some wandering current in the earth, and not to any leakage in the electric tramway rail. Mr. Hutchinson had asked him to put on record the cost of the steel main. It was £1066 under a contract; and this covered not only the cost of the pipe, but the cost of erection and connections at four ends—the whole thing complete, ready for being connected up in the streets at either end. As to the length of pipes he would recommend, he thought he had made it perfectly clear that he advised the use of the lengths mentioned in the paper. He had laid 12-feet lengths for all sizes down to 4 inches. He could not get 3-inch pipes cast in 12-feet lengths; but down to 4 inches, he always used the 12-feet lengths. He paid a visit to one of the great pipe-founders not long ago, to see whether there was any practical difficulty from their point of view in casting 15-feet pipes with spigot and socket joints; and he found that, though they would need considerable pressure to carry out the alteration, it was perfectly feasible. Any effect on Leeds mains by electrolysis had not been apparent as yet. He had been watching very closely every time the ground was opened in proximity to the electric tramways; but he had not come across the slightest indication of electrolysis in the gas-mains. He did find one or two service-pipes which would come within the debateable line; but he should not like to say positively that the effects he saw were electrolytic, though he feared they were. As far as the cast-iron mains were concerned, he had not found anything of the sort. In answer to Alderman Miles's question as to whether he had laid large pipes in long lengths, he had not up to the present been able to get pipes of 12 inches diameter and over in longer lengths than 12 feet; but he was still pressing for them. When the contract for Leeds was let this year, he altered the specification for all sizes up to 12 inches to be in 12-feet lengths; but only three tenders were received. These, however, were from three of the best makers in the country. Of course, there was a medium in all things; and while they did not want their pipes in short lengths, they did not require to run to the other extreme, and get 18, 20, or 24 feet lengths, because then they would be getting near the difficulty he had foreshadowed—the risk of fracture due to the inelasticity of the mains. Nearly the whole of his 36-inch cast-iron mains were laid in the way he suggested—three jointed together at the top, and all lowered into the trench together. He was glad Mr. Shoubridge had carried his (the author's) idea a little bit further, and suggested occasional testing-stations for electric currents along the length of the mains. The other suggestion he had already adopted—that was, at all points where there was special danger he had covered the pipes over with a shield of wrought-iron plate.

There were only sixteen applications received for the appointment of successor to Mr. W. A. Valon; and out of these the Committee have selected five gentlemen for personal interviews at Ramsgate next week, when the final choice will be made.

ESSAYS AND REVIEWS.

SOCIÉTÉ TECHNIQUE DE L'INDUSTRIE DU GAZ.

Annual Meeting in Paris.

LAST Tuesday was the opening day of the Twenty-ninth Yearly Meeting of the one and only French Gas Society. The elegant room, known as the Salle Charras, was fairly filled, at the early hour of 9.30 a.m., by about 150 members, all professional men—or supposed to be, as the trade representatives, or "membres associés," are, by the rules of the Society, not admitted until after the first morning's business is over. The weather was dull and threatening, and seemed to emphasize the lessened gaiety that is traditionally supposed to spread over Paris after the winner of the Grand Prix has passed the Judge's box, as it had but two days previously. Apologies were not wanting for the dark clouds and blackness prevailing, which many intelligent Frenchmen still seem to regard as the peculiar and perpetual monopoly, even in June, of England and Englishmen. But the presidential bell sounds, the electric light is switched on, and the business of the morning is proceeded with.

The first item, as usual, was the election of new members—one honorary, in the person of Mr. Andrew Dougall, as President of the Incorporated Gas Institute for 1902-03; 15 professional members, or "membres sociétaires," among whom we note Mr. H. E. Jones, of London, and Herr Weiss, of Zurich; and 6 commercial gentlemen, all of whom were duly declared elected. Then followed the presidential reading of the Committee's report for the past year. Its opening had the customary pathetic interest attached to the annual list of losses by death. The number of the deceased was nine, including one honorary member, regretted by all, Mr. W. R. Chester, one Past-President of the Society, M. François Alavoine (whose obsequies only took place on the 11th inst. at Beauvais), five members, and two associates. The total number of members of all grades in the Society now stands at the respectable figure of 635. The Committee's report closed with a list of contributions received from various gas companies, amounting in all to 22,675 frs., or £907. This led up to the Treasurer's statement, which proved to be very satisfactory. The year's receipts were 56,475 frs. (£2258); while the expenses came to 50,653 frs. (£2026)—the publications of the Society accounting for £376, and its awards for £416. There was, therefore, a surplus of £232; and the capital now stands at the considerable sum of 196,526 frs. (£7860), being an increase during the past twelve months of some £200. The accounts were received with warm applause; and preparations were then at once made for the election of members to serve on the Committee. Five retiring Committee men were eligible for re-election, and as the orthodox phraseology has it, "offered themselves accordingly." These gentlemen were duly returned—a proof of the satisfaction given by their past services; and it was with particular pleasure that we noted at the top of the list Mr. R. S. Gardiner, whose name is so well known in connection with Continental gas affairs. The tenure of office is for three years, though a sixth candidate elected (M. Villiers, of the firm of Messrs. P. de Lachomette, Villiers, & Co., of Lyons) will serve for two years only in place of the retiring President, M. Piaton. Lively interest was evinced in the voting; and with the announcement of the names of those elected (MM. Gardiner, Godinet, Bigeard, Thibaudet, Bouvier, and Villiers), the morning's proceedings were brought to a close.

PRESIDENTIAL ADDRESS.

The first item on the opening of the general congress was, of course, the Presidential Address. There appeared to be some misunderstanding as to whether this was timed for 2 o'clock or 2.30 in the afternoon; for several members arriving at the latter hour were surprised to find M. Piaton already well advanced in its reading. His subject-matter was the ever interesting and important question of the comparative capital and working costs of gas and electric lighting undertakings. "Ought we," he asked, "to remain purely gas men, or ought we to sacrifice to the exacting goddess, electricity?" Without at present following the President through all his valuable points and sound figures—which we hope to be able to give *in extenso* in a subsequent issue of the "JOURNAL"—it may be stated that he finds that the capital cost per gas unit (carcel) placed at the disposal of the consumer, in an average French town of 100,000 inhabitants, amounts to 30·84 frs., or £1 4s. 8d. The comparative figure for the electric unit is no less than 150·45 frs., or £6 0s. 4d. Thus the latter would require on the same basis, nearly five times the amount of capital necessitated by the former unit of lighting. An examination follows into the cost per unit to the consumer, and the quantity obtainable by him. The result is that the electric carcel-hour, generated from a steam central station, is sold at 2·78 times the price of the gas carcel-hour; while the number of gas units sold is 10·33 times the number of electric ones. Further instructive comparisons are made relating to working costs; but enough has been said to understand the interest with which M. Piaton's address was followed, though we hardly think the manner of reading it did entire justice to its matter. We are, nevertheless, sure that the contribution will be much appreciated generally, and will form a considerable addition

to the rapidly accumulating pile of facts in the struggle of gas *versus* electricity.

Presentation of Awards.

The presentation of various awards was made at the conclusion of the presidential address, though one cannot help remarking that it always seems a pity thus to break into the natural sequence of the technical part of the programme. Why not place the prize-giving at the opening of the afternoon's proceedings; thus allowing the President's remarks to preface, without interruption, the papers presented for reading and discussion? Some of last year's papers were reviewed; mention being made of the contributions of MM. Leclerc and Bouvier, members of the Committee, and thus debarred from any other recognition. M. Verdier, of Marseilles, was awarded a medal and 250 frs. (£10) for his two very important papers, which were given in the "Journal" at the time*—one on the subject of the lighting power of gas in a Bengel burner compared with its heating effect in incandescent burners, and the other on the result of carbonizing coals of various sizes. M. Lecomte also received a similar award for his communication on the photometry of incandescent mantles. In this connection, the official report remarked on the wide variations in results obtained from different mantles, and added that the savants had not yet formulated any rules to govern the subject, as the Committee appointed at and by the International Congress of 1900 had still to take up its duties! May it not well be asked, What, if anything, has been done, and when, if ever, will any practical report or steps be issued or taken? Fears were expressed at the time of its nomination that its labours would not be expeditious; but surely something should be definitely arranged, or the Committee dissolved if found unworkable. A third prize was given to M. Laurain, for his paper on the mechanical conveying of coal and coke, though our published translation of it did not convey to English readers any very favourable impression of the novelty or worth of the appliances described.

There were 99 candidates among gas workmen having the longest and best records of service for the Society's usual prizes of 200 frs. (£8). Thirty of such awards were made and the recipients congratulated; their length of employment varying from 27 to 43 years with the same undertaking. Twelve medals of honour were also presented, as customary, by the Government to the most deserving workmen. Of the other regular competitions organized by the Society, no award was made in the category of improvements to incandescent burners; but MM. Boulanger and Roux obtained 500 frs. (£20) out of a possible 5000 frs. for artistic gas-fittings. Under the heading of "Apparatus Showing Marked Improvement in the Manufacture or Consumption of Gas," the Société Française de Chaleur et Lumière were awarded 500 frs. for their radiators or stoves, known in England under the name of Clamond. The official tests upon these stoves, both as regards their heating power and their combustion, were reported to be quite satisfactory in every way; and the sum granted—unanimously—it was hoped would serve as a slight encouragement.

The Reading of Papers.

The way was now clear for a commencement to be made with the long list of twenty-nine papers presented; and the Secretary was at once called upon to read the Committee's communication on the standardization of screw-threads for consumers' gas apparatus. This subject was first raised in 1891, since which time the difficulties arising from every railway, every large firm, and every State Department having its own system, have not grown less. The Committee appointed divided the screws into five classes, of which, however, they only dealt with one—viz., mechanical screws used in construction, and having a diameter above 6 mm. The threads of gas-tubes were not insluded in the investigation; but this drawback has now been overcome by the present report enlarging upon the original one co as to embrace this division—and not the least important one—as well. Without going into the mechanical details and theoretical calculations of the subject, initial difficulties have been overcome, and a standardization, known as the Système International (S.I.) has been evolved and ratified, and is now largely adopted throughout Europe. The tabulated results given in the paper show that the often urged difficulty of the adaptation of the metrical system to the exigencies of screw cutting and standardizing are now practically overcome, and international unanimity on the subject all but assured.

The Committee's second paper, summarizing the work of the Commission appointed to inquire into the Paris Gas Affairs after the expiration of the Company's concession in 1905, was taken as read, though M. Lecomte called in question the accuracy of certain figures therein relating to benzol enrichment. M. Godinet, of Lyons, then gave a description of a bench of six arches of nine inclined retorts now at work at Lyon-Vaise. The installation, carried out by the firm of Messrs. P. de Lachomette, Villiers, and Co., is very much on the lines of those at Geneva and Zurich, which have already been described in our pages. The retorts are 3·52 metres (11 ft. 6 in.) long, the outside producers are placed underneath the charging-stage, the coal breakers and elevators are in duplicate, a De Brouwer conveyor takes away the hot coke, and the plant is driven electrically. The furnace fuel comes out at 16 per cent., or 16 kilos of coke per 100 kilos of coal carbonized; and the cost of labour has, of course, been very largely reduced in every way. The author is careful to emphasize the fact that the plant has been arranged only for local requirements, and it is not at all intended to regard it as the best combination for general adoption. On the contrary, he points out the advantages that would accrue, where possible, from having long retorts, twelve and even fourteen in a setting. This installation at Vaise Gas-Works is, we believe, the first in France since the expiration of the Coze patent, and therefore it is of interest as showing and foreshadowing a fresh start and a new opening in the history of inclined retorts.

After an observation or two by M. Salanson, the next paper was taken. Its author was M. Laurain; and his subject was, as before, and as previously mentioned, the mechanical handling of coal. It was, in fact, a supplementary paper to the one of last year; but referred more particularly to appliances applicable to small works. There was no discussion, and not much of novelty or interest. The afternoon's proceedings terminated by a summary from M. Lencauchez of his long paper of 38 pages on the means of using gas-works coke for the purposes of general industries. The subject is doubtless an important one, and has been treated by the author with great thoroughness. Starting with the classification of coke, he deals with its use in a variety of ways and for a variety of purposes. The scope he has allowed himself even permits of the purification of producer and coal gas being included, as well as other more or less kindred themes. The President announced the adjournment at five o'clock.

Re-assembling on Wednesday morning, a goodly number were present when M. Dandy read a short paper of some local importance at Angers, on a special form of gas-stove for the sterilization of milk. A successful apparatus has been constructed and adopted which has met the particular medical requirements of the situation. The next paper, or rather two papers, were by M. Badon-Pascal, and treated of the always interesting subject of public lighting and public lamps, more particularly with regard to incandescent illumination. Examples of different burners were shown; but there being no questions asked and no discussion, another communication on a similar subject—the system of lighting employed at Creusot, by M. Goiffon—was at once proceeded with. There being still no need of discussion, rapid progress was made; and M. Guillet read a paper by M. Dulac on the scurfing of retorts. The apparatus described, and in operation at the Besançon Gas-Works, consists simply in a Körting injector on a portable carriage, the steam being carried thereto by flexible tubing. After a question by M. Godinet, the reader (M. Guillet) read a paper of his own on the ammonia retained by tar. Experiments had proved the advisability of passing the tar through a shallow and long trough of water to abstract as far as possible the ammonia contained by the tar vesicles.

The same author's second paper was of far greater importance. It recorded in some detail his experiences in the extraction of cyanides from gas. The thirty or more pages of his report were not actually read, but formed the basis of a somewhat long summary. The treatment carried out was to some extent the same as that known as the Bueb process—washing the gas in a sulphate of iron solution—though the Doctor's conclusions were not altogether agreed with. Questions of detail were raised by MM. Verdier and Chevalet and others; and the importance of producing on a gas-works the actual chemicals for direct sale, instead of their bases only for subsequent manufacture by others, was insisted upon. M. Verdier afterwards read M. Burguière's short account of the use at Marseilles of Hignette's centrifugal turbine for the separation of tar from ammoniacal liquor. The applicability of such an appliance is well known, and has often proved of utility.

The succeeding paper was the second contributed by M. Godinet to the congress. In it, he described a new system of guiding gasholders by cable, taking as his text a single-lift 53,000 cubic cubic feet holder constructed at Rodez by the firm of Messrs. Bonnet, Spazin, and Co., of Lyons. The arrangement of cables adopted is one thought out by M. Sauney, of the firm mentioned, and has been noticed in the "Journal," Vol. LXXVII, p. 1514. The system appears to offer certain advantages in several ways compared with the better-known Pease arrangement; the author stating that the life of the cables is increased owing to the absence of any rubbing of one cable against the other, as often takes place above the centre of the gasholder crown. He asserts also—and this appears to be a limitation of consequence to all such systems—that a certain amount of supervision is required to see that the cables do not corrode, or are replaced by new ones in time. The holder at Rodez is only a small one; being 59 feet in diameter and 19 feet deep. It was, however, subjected to adequate tests, which are duly recorded in the paper, and the holder proved altogether satisfactory. It was not made clear what the actual economy had been from the adoption of such a holder, and both M. Piaton and M. Mallet put questions relating to costs.

M. Lecomte, the ever ready and the ever fluent, then took up the attention of the meeting with his paper describing two installations for enriching gas by benzol. The results of some experiments on a practical scale at Beaune were given; the Manager there (M. Delcourt) stating that, after five months' winter's working with an enrichment of 3 to 5 grammes per cubic metre of gas, naphthalene troubles had entirely disappeared. Subsequent remarks from MM. Mallet and Godinet—somewhat sceptical of the efficacy of this relief—drew from the author an admirable

* Vol. LXXVIII., pp. 340, 514.

exposition of the causes of the production of naphthalene deposits and of the action of benzol. In the course of his statement, he called to mind an eminent engineer who had affirmed on one occasion that, so far from benzol reducing naphthalene deposits, it actually produced them!

Time was getting on, and many did not wait to hear a useful little paper from one of the French Society's regular contributors—M. Bouvier, to wit—who this year discoursed on an installation of a fanner for increasing the pressure of gas in mains. In the case referred to, three courses were open: To lay new mains at an estimated cost of some £3000; to erect a central town station costing about £1200; or, thirdly, to put up at the works the installation described, which amounted to but £217, or 5439 frs. Though such arrangements have been adopted in London and elsewhere in England for some time past, the plant mentioned by M. Bouvier is one of the first on the Continent, and as such has more than usual interest attached to it. This concluded a fairly hard morning's work, and the relief of lunch hour was heartily welcomed.

The subject of meters occupied part of the afternoon's *séance*, one of the most interesting papers being a description, accompanied by a full size model, of a new form with balanced drum, called the "Duplex." The main idea underlying its construction was to proportion the speed of the drum to its diameter according to its size, and in all cases to increase the speed so as to obtain a better return from the apparatus. The "Duplex" drum consists of six vanes, and in some respects is not dissimilar to that brought to notice by Mr. T. G. Marsh at the recent meeting of the Gas Institute.

The services of M. Lecomte were soon afterwards again requisitioned for his second paper, forming an inquiry into the question of heating by gas, and relating particularly to the radiators or stoves of the Société Française de Chaleur and Lumière, reference to which has already been made. M. Bachelay's "Three Words Only" took but three minutes, in which short space of time, however, he showed, first, an arrangement for adapting gas-pendants to very high ceilings; secondly, an acetylene lamp for lamplighters; and, thirdly, referred to the need of unification of threads (already dealt with by the Committee), and of bricks.

The next paper was by M. Dulac, but was read by M. Guillet. It was entitled "A Balanced Charging Machine." Its opening phrase, however, seemed at once to carry with it its own condemnation: "This apparatus requires three men to work it." Surely no further comment is needed, as there are several machines for small works that can do better than this. A continuous coke-stove for domestic heating was next described by M. Frère. It has, however, only local applicability, where competition from anthracite, &c., is felt. M. Jouanne had a paper recording the progress of water-gas manufacture; but to all intents and purposes one might equally have read the advertisement pages of the "JOURNAL" setting forth the installations of Messrs. Humphreys and Glasgow, the Economical Gas Apparatus Construction Company, and the Dellwik-Fleischer Syndicate, with those on the system of Dr. Strache added.

Yet once again—and that for the third time—did M. Lecomte rise to explain another of his valuable contributions; the subject on this occasion being competitive illuminants of gas—carburetted air, alcohene, petrol, and alcohol. Several excellent lamps were shown practically exhibiting the competitive power of each, which the talented author thought were more to be feared than electricity or acetylene. Useful figures of reference were tabulated by M. Delahaye, referring to the costs of gas and electric lighting undertakings in sixty towns of Massachusetts from 1900 to 1901. The fact that there are six-and-a-half times as many gas clients as electric light consumers would seem to prove that the latter form of lighting is still an *éclairage de luxe*, notwithstanding all Sir William Preece's assurances as to its being the "poor man's light," and its only fault that it is "too cheap."

M. Pierson read a short paper descriptive of the electric light station of the Tunis Gas-Works; and thus the gas congress ended, as it had begun, with electricity. A few informal words of thanks to the President, formulated by M. Lecomte, to which suitable acknowledgment was made, finally closed the proceedings of this year's gathering of the Society.

THE LEGAL RELATIONS BETWEEN GAS SUPPLY UNDERTAKINGS AND CONSUMERS.

(*Concluded from p.* 1685.)

We have next to deal with a gas company's powers for obtaining payment of its accounts for gas supplied, meter rent, &c.

PAYMENT OF ACCOUNTS.

Gas accounts are rendered weekly, monthly, quarterly, or half-yearly, according to the terms of the agreement between company and consumer, and become due as soon as rendered. The period of grace granted by the company between the date the account is rendered and that on which payment is required to be made differs, of course, very considerably according to circumstances. The law does not give any extended grace to the consumer.

Right to Discontinue the Supply of Gas.—By section 16 of the Gas-Works Clauses Act, 1847, it is provided that if any person supplied with gas neglect to pay the rent due for the same to the company, the company may stop the gas from entering the premises of such person, by cutting off the service pipe, or by such means as the company shall think fit. If the company propose to discontinue the supply because the account due for gas is in arrear, three days' notice in writing to the consumer shall be sufficient (M. G., 1860, s. 21). [For what constitutes good service of such a notice, see note, *ante* p. 1475.]

As the sections give no definition of what constitutes "neglect to pay," or of what is meant by "gas-rate in arrear," it may be assumed that a company would be within their rights in serving a three days' notice of their intention to discontinue the supply, unless the amount due were in the meantime paid, at the same time as the account for gas supplied was rendered—though, of course, such a step would not be taken except in an urgent case. In the absence of any good cause for such exceptional haste, it is possible that the Courts would hold that the consumer had not been allowed a reasonable time in which to pay, and that he had therefore not "neglected to pay;" but no such case ought ever, or is likely to, arise.

Penalty for Wrongfully Disconnecting Supply.—The penalty to which a company would be rendered liable if, through negligence, the supply to a consumer was discontinued after the amount due had been paid, or after insufficient or irregular notice, would be that provided by section 36 of the Gas-Works Clauses Act, 1871, for neglecting or refusing to supply gas to any owner or occupier of premises entitled to the same—namely, a sum not exceeding £2 for every day during which the default continues (*Commercial Gas Company v. Scott* [1875], L.R., 10 Q.B., 400). Probably the company would also be liable to special damages if any were sustained by the consumer as a direct result of such wrongful discontinuance of the supply. A company is liable for damages arising from unskilful and negligent cutting off of a supply of gas (see *Paterson v. Mayor, &c., of Blackburn* [1892], 9, T.L.R., 55).

Entry to Disconnect Service-Pipe.—The words "the company may stop the gas from entering the premises" have been held not to give a company the right to enter the premises in order to disconnect the service at the meter, without permission of the occupier (see *Ramsay v. Brentford Gas Company*, "JOURNAL" Vol. LVI., p. 958). This permission need not be written. All that is required is that the consumer should be informed of the purpose for which the company's servant desires access to the meter, and that he (the consumer) should not refuse entry, so that no question of trespass shall arise. The wording of the Act certainly does not, on the face of it, imply that it was contemplated that the supply might be disconnected at the meter, and the literal interpretation of it may be good law. But inasmuch as disconnecting the supply at the meter costs practically nothing, whereas to dig up and make good a road (perhaps paved with wood or asphalte) for the purpose of cutting the service-pipe is a job costing some shillings, or even more than a pound, for which expense the consumer is liable, and may be sued (G. C., 1871, secs. 23 and 40), the question of obtaining entry to disconnect ought not—upon those facts being explained to the consumer—to present very much difficulty.

Right to Discontinue Supply to All Premises.—A company's right to refuse to continue to supply gas to a consumer who neglects to pay any sum due by him for gas used extends to all the premises of such consumer supplied with gas by the company, even though the debt remaining unpaid is in respect of one of those premises only. (*Montreal Gas Company v. Cadieux* [1899], A.C., 589). There is no provision in the General Acts empowering a company to refuse to grant a supply to an owner or occupier at one premises if he owes them money for gas supplied to him at other premises; but most gas companies possess that right by virtue of their Private Acts. In the event of a supply being granted to such person at a new address in the anticipation of the account for the former premises being paid in due course, or through the applicant for a supply at the new address not being immediately recognized as a debtor to the company, the Montreal case would give the company the right to discontinue supplying the consumer, unless and until the old debt were discharged to their satisfaction.

Incoming Tenant not Liable for Debts of Outgoing Tenant.—A company is not entitled to require from the next tenant of any premises the payment of any arrears left unpaid by the former tenant, unless such incoming tenant has undertaken with the former tenant to pay, or exonerate him from the payment of, such arrears (G. C., 1871, s. 39); but the company must, notwithstanding any such arrears, in the absence of collusion between the outgoing and incoming tenant, supply gas to the incoming tenant, subject to the usual conditions as to contract and security, on being required by him so to do (M. G., 1860, s. 39). Where a company is "entitled to require" from the incoming tenant payment of arrears due from his predecessor, it has been held (*Gaslight and Coke Company, v. Mead* [1876], 45, L.J.M.C., 71) that the company has no right to summon the incoming tenant for payment of those arrears—it can only refuse to supply gas unless the arrears be paid (*Pzara v. Gaslight and Coke Company, ante* p. 968). The question of the right to summon for payment is, however, being raised afresh by *Gaslight and Coke Company v. Cannon Brewery Company*, in which case an appeal is now pending (see *ante*, pp. 95 and 967). The Gaslight and Coke Company have power to require payment of arrears from an incoming tenant who has

purchased the business of the outgoing (Gaslight and Coke Company's Act, 1872, s. 18).

Powers to Recover Debts.—In case any person who has been supplied with gas shall neglect or refuse to pay the amount due in respect to such supply, any Justice or Magistrate (M. G. 1860, s. 2) may issue his summons to such person, requiring him to appear at a time and place named therein, and then and there to show cause why the sum so demanded should not be paid; and if on the appearance of such person, or, in default of appearance, after proof of the service of the summons, either personally or at the last known place of abode or of business of such person,* no sufficient cause can be shown to the contrary, any Justice may issue his warrant of distress for the seizure and sale of the goods and chattels of such person, for the recovery of the amount which may be proved before such Justice (or Magistrate) to be due from such person, together with such costs (including the cost of cutting off the gas, if the same has been cut off by the company) as may to such Justice seem just and reasonable (G. C., 1871, s. 23). Any Justice who issues a warrant of distress in pursuance of the foregoing section may order that the costs of the proceedings for the recovery of the money to be levied shall be paid by the person liable to pay such money, and such costs shall be ascertained by the Justice, and be included in the warrant of distress for the recovery of the debt (G. C., 1871, s. 43). Debts due for gas supplied, rent of meter, or cost of fixing same, or any expenses lawfully incurred in cutting off the gas supply, may be recovered in like manner as a penalty under the Gas-Works Clauses Act (G. C., 1871, s. 40), or, together with full costs of suit, in any court of competent jurisdiction. The latter remedy is in addition to the other remedies possessed by a company for the recovery of such debts (G. C., 1871, s. 44).

Recovery in Like Manner as a Penalty.—Every penalty imposed by the Gas-Works Clauses Acts, or any Special Act therewith incorporated, the recovery of which is not otherwise provided for, may be recovered by summary proceeding before two Justices or a Magistrate (G. C., 1847, s. 40, and the Railways Clauses Act, 1845, s. 145). The procedure of the Court in such actions, as also the right of appeal on points of law, are determined by the Summary Jurisdiction Act, 1848, secs. 19 and 21 (as amended by the Summary Jurisdiction Act, 1879, s. 21), and by the Summary Jurisdiction Act, 1879, s. 33 (see *ante*, p. 1685). Moreover, if any party feels aggrieved by any determination or adjudication of any Justice with respect to any penalty or forfeiture under the provisions of the Gas-Works Clauses Act or any Act incorporated therewith, such party may appeal to the General Quarter Sessions (G. C., 1847, s. 40, and R. C. 1845, s. 157).

Time-Limit as to Proceedings in Court of Summary Jurisdiction.—Application to a Court of Summary Jurisdiction for the issue of a summons for payment of a debt must be made within six calendar months from the date the debt accrued, if the proceedings are taken in pursuance of the Gas-Works Clauses Act, 1847, sec. 40, with which are incorporated secs. 140-160 of the Railways Clauses Act, 1845, as amended by the Summary Jurisdiction Act, 1884. (See *East London Water-Works Company v. Kyffin* [1895], 1 Q.B., 55).

Consumer Ceases to Require a Supply.

There is no section in the General Acts definitely stating the length of notice required to be given to a company by a consumer as to terminating the agreement between them for a supply of gas; but many companies have sections in their Private Acts requiring twenty-four hours' notice in writing to be given to them that a consumer wishes to terminate his liability, and continuing that liability until twenty-four hours after the receipt of such notice. Other companies embody similar conditions in their agreements with consumers, and print those conditions upon all applications for accounts due.

The Metropolis Gas Act provides (sec. 21) that no contract for the supply of gas shall contain any condition for requiring any notice by a consumer discontinuing his supply of gas or meter which makes him liable to pay more than one month's rate or meter-rent after the time of the service of the notice. No company, however, require so long a notice of discontinuance. The outgoing consumer's liability does not, of course, continue after the company have received from his successor an application for a supply of gas, even though the outgoer has not given notice of his ceasing to require the supply.

THE BOARD OF TRADE RETURNS TO MAY 31.

The Need of Efficiency Emphasized.

The Board of Trade returns for the month of May and the five months ended therewith give no indications of any revival of industrial activity. The exports of coal show a considerable decline during the past month, although, owing to the continued increase in the shipments of "bunkers"—which do not pay duty—the total exports for the five months establish a record. The exports for sale last month were 3,865,311 tons, compared with 4,282,939 tons in May, 1901, and 4,170,220 tons in 1900. Probably, however, some of this decrease is due to the late opening up of navigation in the Baltic, and may be partially counterbalanced in the next two or three months. Exports for sale during the first five months of the year amounted to 17,145,390 tons, against 17,256,063 tons and 17,893,482 tons in 1901 and 1900 respectively. Including "bunkers," however, the figures read: 1902, 23,057,567 tons; 1901, 22,546,962 tons; and 1900, 22,637,636 tons. So that the home market has not benefited at all by the lessened sales to foreign countries, the total exports being 500,000 tons greater than ever.

It is scarcely surprising that, in the face of these figures, Sir Michael Hicks-Beach should have declined a fortnight ago, to accept, as an amendment to the Budget Bill, a clause reducing the export duty from 1s. to 1d. per ton, though it will be noticed that, in the course of the debate, he remarked that "the Government were bound to consider as time went on the effect of the coal-tax on the industry; but for that purpose the business of the present year would afford an infinitely better standard than that of last year." As he made it perfectly clear when the duty was first proposed, the Chancellor of the Exchequer has no desire to injure the coal trade by the imposition of that duty, nor have we supported the duty in any spirit of vindictiveness towards the trade—little though it has done in the past two or three years to cultivate good relations with the gas industry. The tax was imposed by the Chancellor because the financial position of the country demanded increased taxation, and because it appeared to him that a minimum of injury would be done to trade by such a tax; and on those grounds alone have we supported it.

The exports of iron and steel show a very slight improvement compared with last year, but are far below the level of 1900; while the increased imports more than counterbalance the improvement in the exports. The figures for the five months are as follows: 1902, gross exports 1,277,364 tons, less imports 282,282 tons—net exports, 995,082 tons; 1901, gross exports 1,161,677 tons, less imports 147,803 tons—net exports, 1,013,874 tons; 1900, gross exports 1,659,211 tons, less imports 78,224 tons—net exports, 1,580,987 tons. These figures show a steady loss of business to our manufacturers, and a consequent steady decline in the amount of coal used in the iron and steel trades. This tremendous reaction from the position of affairs two years ago was naturally the subject of much comment and discussion at the recent annual general meeting of the British Iron Trade Association (with whose report we hope to deal more fully later on), when the question of the influence of American competition on our markets was also considered. The President of the Association, Mr. E. Parkes, M.P., pointed out that the total exports of British iron and steel fell from 3,717,000 tons in 1899 and 3,545,000 in 1900, to only 2,900,000 tons last year—"a serious thing for the Association to consider;" while imports have gone up from 645,000 tons in 1899, and 761,000 tons in 1900, to 868,000 tons in 1901, and at the present rate will exceed 1,000,000 tons in the current year. The production of pig-iron in Britain has fallen nearly 20 per cent. in two years—from 9·3 to 7·7 million tons, or only five times the production of pig iron in the United States in the month of April. When it is considered that not long ago the annual output of iron in the two countries was equal, and that now the United States are producing at a rate equal to 18 million tons per annum, while we are not turning out 8 millions, the strides taken in recent years and the important influence now exercised in the industrial world by our American competitors, are easily recognized. What manufacturers in this country have to prepare to meet is the situation that will arise when America ceases to consume, as she does now consume, practically the whole of her gigantic output. Fortunately, the British Iron Trade Association are fully alive to the necessity for such preparation, and are about to publish a full report on the whole subject of American competition in the iron and steel trades—a report which should furnish very interesting reading.

As an indication that the members of the Association are looking round them for weak spots in our industrial organization, we will make one quotation from the discussion at the annual meeting, which exactly hits a joint in the harness at which we were aiming the other day. "What I lament," said Mr. H. J. Skelton, "is the absence of enterprise in the existing trade. It is not only want of education in the men, but of education in the directors, through which expense is often caused. Some of these directors are often unfit for their places, and they are presuming to direct when they have no proper capacity fitting them to direct. Their mere capital investment does not enable them to direct the interests of a great commercial concern." We wish that the shareholders of some concerns in the gas industry would realize the truth of the last sentence. Money is not a substitute for brains and commercial capacity; and the stress of competition will make that more clear every year we live.

See note, *ante*, p. 1475.

ELECTRIC LIGHTING MEMORANDA.

The Deputation of Electricians to the Board of Trade—Mr. James Swinburne on the Backwardness of British Electric Industries—Mr. G. Balfour on the Situation—The One Thing Needful.

The long-simmering discontent of the British electrician with the lot to which an unsympathetic Legislature has condemned him, found constitutional vent last Wednesday, when a deputation from the Institution of Electrical Engineers, headed by Mr. James Swinburne, waited on the President of the Board of Trade, with the object of "giving him a good talking to" on the

subject of their grievances. For some time past, the Institution have been deeply moved to formulate these grievances; and a Committee was formed to get up a case against existing legislation and its effects on the electric industries. The proceedings of this Committee have been duly reported, and some of them make entertaining reading. To their credit be it said, the Committee went about their work with an open mind, and took statements from all sides. The result, however, is rather confusing, because it is difficult to judge whether the advocates of private enterprise or the professed municipalizers had eventually the better of the argument. Nay, more—some of the strongest of the arguments for private enterprise peeped out in the admissions of the municipal witnesses; while several of the independent experts condemned both parties indiscriminately. In the end, however, Mr. Swinburne got a team together to play something like a single-intentioned game before Mr. Gerald Balfour. To do this, however, he had to drop all the municipalized contingent, and betake himself to Whitehall in the company of such sign-posts of the opposite camp as Mr. Sydney Morse and Mr. J. Clifton Robinson.

Finding himself in this galley, Mr. Swinburne spoke to his brief. The metaphors are getting somewhat mixed; but so was the case. In the first place, Mr. Swinburne had to dilate upon the objectionableness of the "obstructive powers possessed by local authorities in regard to electrical undertakings," and waxed eloquent on the text that electrical enterprises should be limited by economical considerations only, and should not be interfered with by local authorities abusing the powers which Parliament favoured them with in 1882; but certainly not for the purpose of obstructing electrical progress. It suited Mr. Swinburne to ignore the general state of the country, and the vagaries of the electrical speculators which led to the 1882 legislation. But Mr. Balfour did not forget it later on. In addition, the deputation wanted to abolish compulsory purchase; to reduce the cost of parliamentary procedure; to have the electrical staff of the Board of Trade strengthened; and to obtain the promise of a Royal Commission to inquire into the whole question of electrical legislation. Mr. Swinburne, who is not lacking in a sense of humour, must have felt it difficult to keep a straight countenance while pelting the minister with these paper bullets.

In reply, Mr. Balfour professed his sympathy with much that had been said by the speakers; but he forthwith went to the root of the matter by showing that the relative backwardness of the British electrical industries is not due to defective legislation, or to regulations of an oppressive character, or even to the abuse of their powers by the local authorities, but is mainly to be explained by the fact that electricity does not happen to be so much in request in the United Kingdom as it has been in some other countries. Citing the example of America, the President of the Board of Trade remarked that this is a new country, very sparsely inhabited, with towns growing up like mushrooms—above all, with comparatively few established interests to contend with. The field is open, and capital can readily flow in through all these new channels. As somebody else has pointed out, there is no gas in America outside the large cities; and the competition of the electric light was with kerosene only. Similarly, the people jumped at the roughest electric tramcar, in the absence of decent roads. How many penny omnibuses are there in all the United States? The President of the Board of Trade did not say anything about the alleged supremacy of electrical industries on the Continent of Europe—very probably because he was afraid of committing himself. He must know quite well that Continental electrical enterprise has overleaped itself, and is actually floundering in the deepest financial mire. What can Governments do in such circumstances?

Yet, not to dismiss the deputation without giving them a grain of comfort, the President of the Board of Trade went so far as to throw open for discussion the question of the local authorities' power of vetoing electric traction and lighting schemes. He admitted that a Departmental Bill has been drafted with the object of freeing electric traction schemes from the domination of the local authorities, but confessed that the political power of these bodies is so strong in the present House of Commons that there is not much chance of overriding it. Sir Albert Rollit is a force to be reckoned with, when he has all the Town Clerks at his back. Yet he must be careful; for there are not lacking indications that Parliament might kick against the Town Clerks' tyranny, if carried to much greater lengths. Mr. Balfour has another Bill in a pigeon-hole of the Board of Trade. It is a measure to enable electric power generation schemes to be promoted by Provisional Order, and not always by Bill. There is no saying when these measures will be introduced—certainly not this year. Somehow, it is difficult to take the suggestions of the deputation with a high degree of seriousness. It was an electricians' "demonstration," doubtless; but though they did not go to Whitehall with bands and banners, like the 'orny 'anded resorters to the Reformers' Tree in the Park on Sundays, there was a Trade Union flavour about the oratory. Quite innocently, of course, the City Editor of the "Pall Mall Gazette" on Thursday gave the show away by remarking that "if the promised Bills go to the root of the matter and are passed into law, development in matters electrical will come with a rush, surpassing anything hitherto experienced; and men who can discriminate should have many opportunities of securing really good things in the way of investment." It is only another electrical "boom" that is wanted, that is all.

THE PRICE OF GAS OILS.

THE constitution, valuation, and prospects of gas oils have been the subjects of recently published compositions; but little has been said to indicate the remarkable effect that the collapse of the high values ruling for oil in 1900 has had on the balance-sheets of those gas companies who are considerable buyers. The decline, as those buyers well know, has been gradual; but from all appearances the bottom price has now been reached. How long that price will continue it is hard to predict; but an authority on the subject states that in the near future the tendency will be to slightly higher figures. But the feeling in the market conforms with a remark made in the article in these pages on June 3 in which "The Prospects of the Gas Oil Trade" were discussed, that "the late snap-rise in the price of gas oil is not likely to be repeated in a hurry." So far, so good; but more on this point presently, after a reference to a few actual figures which bring to light, in an impressive way, the financial importance to carburetted water-gas manufacturers of the tremendous drop which has occurred in price since 1900.

There is reliable authority for saying that the last contract for oil made by the Gaslight and Coke Company was under 2d. per gallon; while in 1900 they bought at about 4¾d. per gallon. Now this Company, *when oil is cheap*, will probably use not far short of 100,000 tons a year. Assuming this computation to be correct, the difference in the price between the oil purchased in 1900 and that which they have now contracted for would represent not far short of £300,000 per annum. It must not be taken from this, however, that they have actually saved this amount, as, at the high price of 1900, the consumption of oil was not anything approaching that named, or that which it is likely to be at the figure they are now paying. There is another Company in the South of England, whose use of oil amounts to about 6000 tons per annum; and the saving between the price they paid in 1900 and that which obtains to-day is equal to, in round figures, £2 10s. per ton. A simple calculation shows that in their case the difference represents £15,000 per annum. As already remarked, the decline in price has been gradual; and, even in the last six months, the reduction has been of an extent which, could it have been foreseen, would have no doubt made a substantial difference in the magnitude of the contracts entered into by some companies. The high prices which gas oil commanded a year before, no doubt influenced them in closing for a supply for a length of time at a price which was regarded as comparatively cheap. There is the case of a north country gas company who, as late as November, 1901, contracted for a considerable quantity, which, if purchased at the prices ruling to-day, would have meant to them a saving of at least £10,000 a year. This must be rather galling to them—more particularly if the contract (as we have reason to believe it is) is of some duration. Even within the last three months, the reduction has been sufficient to make a material difference to purchasers. As lately as March, a company within an easy journey of the City entered into a contract at ½d. per gallon higher than the prices ruling at the time the information was given a few days since. This ½d. is equal to 10s. a ton; and, as the company in question consume 8000 tons a year, the ½d. a gallon represents in their case £4000 a year. In making their new contract for oil, the Gaslight and Coke Company have done something over which they may well shake hands with themselves.

In the article on "The Prospects of the Gas Oil Trade," to which allusion has already been made, it was remarked that "it cannot be forgotten that not very many months ago the oil market was against buyers," and that "it would be waste of time to inquire now how far this condition was natural and how far it was artificial." It is indirectly suggested that this position is a wrong one to adopt; that the condition of things existing eighteen months or two years ago was artificially created; and that herein there is a sufficient reason for inquiry and the publication of information in order that buyers of gas oils may know that it is only by a distribution of patronage, and the keeping alive of competition, that they can prevent a repetition of the inflated prices commanded in 1900. It is held in certain quarters that it is not only the greater available supply that has brought about the present low level of prices, but competition; and if competition can be strangled, what has happened may happen again. The point is put before us in this way: For many years the American product had practically the monopoly of the whole of the gas oil business in the country. Then commenced the importation of Russian gas oil; but its competition was treated with contempt by those already in possession of the field with the American distillate. But, as Mr. R. Ross and Mr. J. P. Leather have shown, the American and Russian oils are practically of identical merit; and this gas engineers were not long in finding out. The establishment in the market of the Russian oil got stronger and stronger; and its competition could not longer be ignored. As the story goes, there came an agreement, under which quotations were made. Hence, partly, the inflated prices. In the progress of events, when prices were at high-water-mark, Borneo solar oil was introduced, and then Texas oil made its appearance. It was the advent of fresh competition that led to the breaking up of the understanding, as the information runs, existing between the suppliers of the American and the Russian gas oils. With a free hand once more, the suppliers were able to quote as they choose; and the inevitable consequence was

down came prices in the struggle for the retention of business, and the keeping back of competition. This, it is said, is accountable as much as over-production for the reduction of prices that has occurred to the extent indicated in the second paragraph of this article.

With the price now obtaining in the market here, it is asserted that it does not pay to import the Russian solar oil; but we have no figures to satisfy us whether it does or does not. But the statement is here for anyone to contradict if it is not a fact. If, however, it is so, it puts the Russian gas oil out of present competition, seeing that the American oil is of equal value to the gas maker. Then Borneo oil for gas producing purposes is altogether out of the running according to Messrs. Ross and Leather's experiments; and therefore it is not surprising to be informed that it has been withdrawn from the gas oil market. There remains the Texas solar oil which has not yet been produced of a quality to equal the American product. Therefore, for the time, the American oil appears to have regained the monopoly—so much so that, as previously remarked, it is rumoured there may be a little creeping up in price. But if this be so, the Russian oil will soon make its strength felt once more; and what that strength is was shown when dealing with the consular reports in the "JOURNAL" for June 3. Assurance is given that in a very short time Texas solar oil will be here of a quality which will successfully compete with the American oil for gas-making purposes; laboratory experiments "on the other side" having proved that it contains the requisite quality of oil. There has been some little difficulty as to the proper points in the distillation of the crude material between which to take off the grade of oil best suited to gas making; but this, it is stated, has now been determined. In this connection, it may be of interest to gas makers to mention that Mr. Boverton Redwood certifies that the last cargo of Texas oil imported contains 0·2 per cent. of sulphur, that its flash-point is 162° Fahr., and its specific gravity ·886. There can be no denying its importance if the prediction as to Texas solar is fulfilled. Price is not everything; quality has also to be taken into account. If in both respects, Texas solar oil proves itself, gas engineers will heartily welcome it. It will be to their interest to help to keep a keen edge on the competition in the market; but competition, as they have frequently been reminded by the coal people does not always keep prices where the gas maker would like them to be. However, some of the large gas oil buyers recognize what it is to their interest to do; and so altogether the outlook gives hope that the day is far distant when we shall see a recurrence of the prices ruling in 1900.

THE GAS AND WATER STOCK MARKET.

(For Stock and Share List, see p. 1796.)

THE Stock Exchange last week had already begun to feel the approach of the general dislocation of business inseparable from the Coronation preparations. The ordinary fortnightly account had to be shortened down to such an extent as to impede dealing to a great extent; so that the best which markets could be expected to do was to keep firm, and not all of them could do that. However, changes in price are about as many in one direction as the other; and the gains and losses are not very considerable. First-class investments are still in good demand, though Consols were rather easier. There was a fair demand for money in the Money Market, and discount rates ruled firm. Business in the Gas Market was maintained at a very fair volume, especially when the general quieting-down of all departments is taken into consideration; and one or two issues were a good deal more conspicuous than they have been for some little time past. Changes in quotation, however, were few, and for the most part inconsiderable; but they were all in the upward direction, with one notable exception. In Gaslight issues, there were dealings daily in the ordinary at very steady figures, ranging from 94 to 95. One bargain was, in fact, marked at 95¼; but it stood quite alone. The secured issues, although not very active, were conspicuously strong in response to the general inquiry for high-class investment securities. The maximum improved a point; and the preference no fewer than 3¾. South Metropolitan was pretty brisk, and well maintained the position it had attained the previous week, but gave no sign of pushing higher. Commercials were quite neglected. In the Suburban and Provincial group, there was absolute stagnation on the Stock Exchange; but in the Mart some good parcels of West Ham and others were readily disposed of at substantial figures. In the Continental Companies was the only instance of weakness—Imperial dropping on Thursday to a mark of 202; but afterwards it promised a fair recovery. European and Union were firm. Among the undertakings located in the remoter world, Buenos Ayres debenture and San Paulo had a moderate advance. The Water Companies again had an uneventful existence, awaiting their fate at the hands of Parliament; and only one change in quotation was the result of the week's operations—New River being marked lower.

The daily operations were: Gas was decidedly quiet on the opening day, but prices were well on the rise. Gaslight maximum advanced 1, ditto preference 1½, and Buenos Ayres debenture 1¾. Tuesday was more brisk; Gaslight ordinary being especially active, but quotations were not changed. Business on Wednesday was a little slacker, but prices were firm, excepting for Imperial, which dropped 1. In Water, New River declined 5. Thursday recovered activity, and prices generally were good. Gaslight preference rose 1; but Imperial receded 1. Friday fell very quiet, but continued strong. Gaslight preference advanced 1, and San Paulo ½. Saturday was quiet and unchanged.

BURNING LIQUID FUEL WITHOUT STEAM BLAST.

THE recent revival of the suggestion to use liquid fuel for steam raising instead of coal, especially in the case of marine boilers, has already been discussed in the "JOURNAL;" and a question has been put on the subject which as yet remains unanswered. In view of the great importance that would attach to a perfectly satisfactory solution of the problem of burning heavy petroleum and coal oils and tars for industrial and navigation purposes, we have watched all that has been published on the subject in the Technical Press, particularly in the journal of Dr. Dvorkovitz, the "Petroleum Industrial and Technical Review." For reasons stated, we have been unable hitherto to see in the modern revival of the liquid fuel question at the instigation of the "Shell line" people, any new fact of sufficient weight to turn the scale against solid fuel, under ordinary conditions. It is not enough to ring the changes upon steam injector parts; and references to the performances of the Holden liquid-fuel locomotives on the Great Eastern Railway are distinctly lacking in freshness. The radical defect of all steam injector fluid burners is the consumption of steam, which is part of their nature. This is objectionable enough, by reason of the waste, on land; but at sea the loss of steam is a very serious consideration indeed. The constant supply of fresh water necessitated in this way is a formidable requirement on an ocean-going steamer, whether the water is carried or condensed on board. The trouble was not seriously felt in the Black Sea fleet of oil steamers, which were the first to burn liquid fuel regularly, because the voyages are short. For long sea trips, however, the system has been regarded askance on this account. Besides, the noisiness of a steam-blast makes it impossible in many circumstances afloat and ashore.

The obvious solution of the problem therefore lay in a good liquid fuel burning system which should dispense with a steam-jet; and the field of selection is immediately reduced to something with hot air. For, of course, the essential quality of a generally useful oil-burner is that it should be capable of burning all the fluid required to do the work in request. Thus, it must be an assisted, or forced combustion, arrangement. No mere dribbling furnace is powerful enough for general purposes, though it can be made to heat a middle-sized setting of gas-retorts. A communication has been made to the "Petroleum Review" by Mr. R. A. Meyer, the Superintendent Engineer of a line of Dutch steamboats sailing between Batavia and Singapore, claiming that his patented arrangement for burning liquid fuel without the aid of a steam-jet has worked on these boats for three years with complete satisfaction—realizing an economy of 37 per cent. on the use of Welsh coal. This information is valuable enough to warrant our reproducing some of the particulars of Mr. Meyer's system.

The method employed is the pumping of the oil at high pressure into the furnace, by means of a special donkey pump, which exhausts into the ship's condensers; thus avoiding the loss of water. On its course from the tank to the pump, and thence to the furnace, the oil is heated and filtered by the arrangement shown in the accompanying plan and elevation. In Diagram I., A is a valve-box for controlling the suctions and deliveries of the oil storage-tanks. B is a preliminary warming appliance, which slightly heats the oil by means of the exhaust steam from the donkey pump on its way to the condenser. C are oil-filters—one being kept in reserve. D is the pump, also in duplicate. E is the heater which raises the oil to 200° Fahr. by means of the live steam on its way to the pump. F is a pressure-gauge on the oil; G a thermometer; and H a loaded escape-valve for regulating the pressure on the oil. By the various connections shown, it is possible to circulate the oil before starting the burner, in order to work it up to the desirable temperature. As soon as the thermometer before the furnace indicates 200°, the admission cock is opened and the oil sprayed in. Fig. 2 shows the Körting injector used for the purpose.

With one injector it is not possible to spray into the furnace more oil than will make steam for about 80 indicated horse power. Two or three such injectors must therefore often be fixed to one furnace. As regards the air supply, this must be after the rate of 200 cubic feet per pound of liquid burnt; and it must be well heated and brought into as complete contact with the oil-spray as possible. The arrangements of the furnace have accordingly to be carefully worked out. In the first place, the air should completely surround the oil-spray. Next, the spray must not impinge upon any solid substance, as this would check the combustion. Also, the furnace must be brick-lined, in order to accumulate heat and keep the ignition going at a high temperature. The proportions of the bridge opening at the back of the furnace must be carefully adjusted by experiment; otherwise the fire will smoke. Experience with Borneo oil showed 0·6 square foot per burner to be about the right amount.

Diagram II. shows pretty clearly Mr. Meyer's solution of the problem thus stated. In it is shown the boiler furnace which

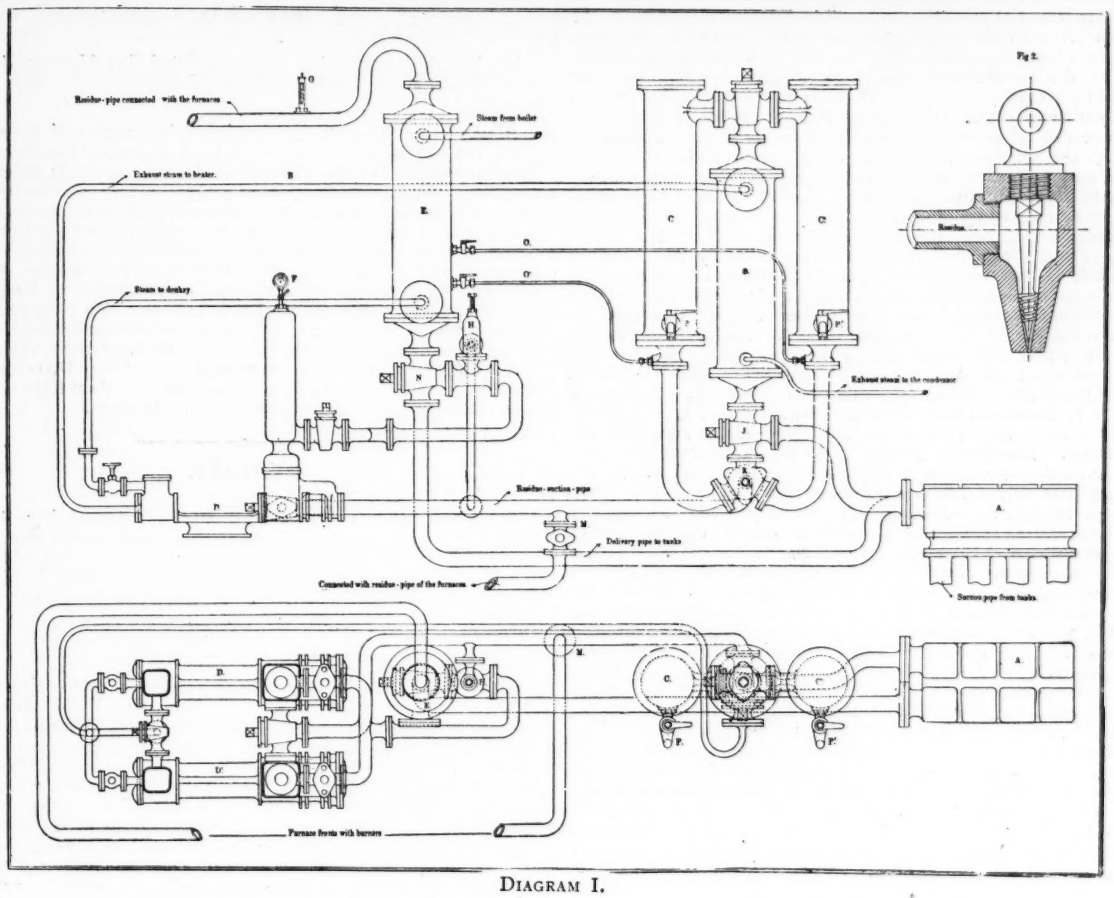


DIAGRAM I.

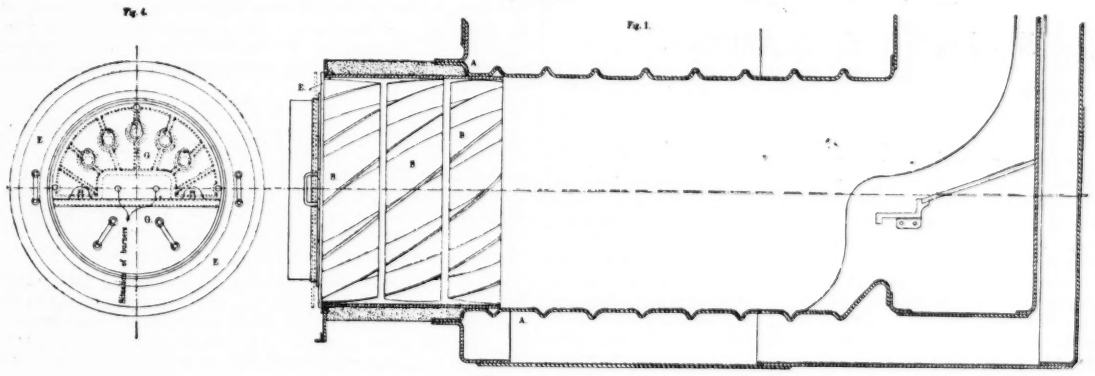


DIAGRAM II.

has been for eighteen months running steamers working up to 1350-horse power. It will be perceived that, starting with a common shell boiler, the furnace-front, dead plate, fire-bars, and bridge are all removed. The front end of the furnace tube is closed with a cap of steel metal B, which forms an annulus with the

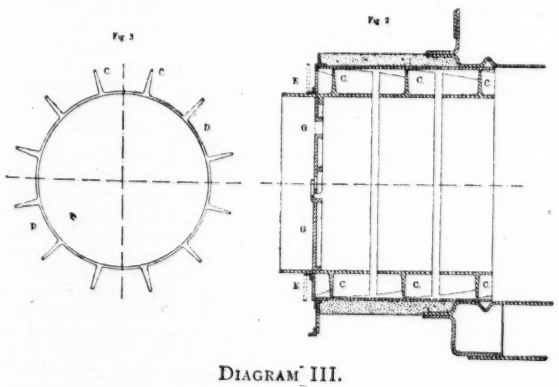


DIAGRAM III.

tube, leaving room in the interspace for some spiral air-guides, which cause the inflowing air to take up heat from the casing before entering the interior where the oil is burning. Essentially, this is the whole device. There is no provision for an air-blast; but the air is heated by contact with the metal of the cap, which is lagged in order to retain its heat in the air passages. The ring portion of the cap (Diagram III.) is made in short lengths, which do not quite meet. This facilitates the manufacture of the appliance, and the gaps are openings through which part of the air enters to ignite with the oil as it issues from the injectors. The bulk of the combustion is completed further on, at the end of the ring or cap. There are dampers, &c., to facilitate control of the fire, and allow inspection; and every injector has its cock.

The whole arrangement is very simple; and Mr. Meyer says it works well. Of course, the air supply must be nicely adjusted to the quantity of fluid to be burnt; and the provision for this adjustment is not at all complicated. The key to the device is the adaptation of the intense local heat-radiation of the oil-flame, to heat the air going into the furnace to complete the combustion. The very back of the fire tube appears to be filled in with brickwork.

THE ILLUMINATION OF LONDON.

THIS week London will be transformed at night time into a veritable city of light. For months gas and electrical fitters have been busy throughout the hours of daylight on the work of outlining and decorating with devices, legends, and sentiments the açades of many of the more important structures in every street and place from East to West for the luminous displays that

celebrate the Coronation, and symbolize the gladness of the people. Never before, either here or on the Continent, has there been such a vision of splendour as will be witnessed in central London during the next few nights. In the work, gas and electricity are, perhaps, having about an equal share of patronage; and their illumination will be given through glasses of many hues and cut crystal devices, which have been lavishly applied to produce the gorgeous spectacle. Such a busy time as this has made for the fitting branch of the gas industry has, it may safely be said, no counterpart in its history. In the City, gas is being very largely employed in the illuminations. Gas devices will be found at both the Mansion House and the Royal Exchange; and a unique display is being made by the Bank of England. Here no less than 30,000 gas-burners and rich crystal devices have been fitted; and what can be done in the way of intelligently planned gas illumination will be witnessed on the Bank's dingy walls in full beauty. All the banks, the insurance, and the other offices in the heart of the City are making large displays with both gas and electricity. Searchlights are being mounted on the Monument; and London Bridge is festooned with lamps. Preparations for magnificent displays have also been made along the direct routes to the West-end. Blackfriars Bridge is to be illuminated with gas; and Waterloo Bridge will have 2500 electric lamps. In the illumination of the Embankment and Gardens as far as Westminster Bridge, 20,000 lamps will be employed. Throughout Westminster the illuminations will be on an extensive scale. Clubland will be well worth a visit; gas flambeaux taking there an imposing part. In the West-end proper and beyond, the preparations are on an exuberant scale of splendour. One of the most curious examples of lighting for those who delight in things ancient will be found in Great Pulteney Street, near Piccadilly Circus. It takes the form of 150 triangular oil-lanterns, which were manufactured for celebrating the victory of Trafalgar, and were subsequently used for the Waterloo rejoicings. They are in a good state of preservation. Alongside the modern gas and electric lighting, they will have a strange appearance. The new Westminster Cathedral is to have a unique illumination by electricity. No one who is interested in lighting will, if opportunity permits, fail to make an inspection of the chief centres of display next Thursday and Friday. The work has been well done, expense has not been spared, and taste and intelligence have been brought to bear upon design to a degree which, it is promised, will give abundant satisfaction.

MR. JOHN WEST IN AMERICA.

Readers who were at the meeting of the Gas Institute, or who have perused the report of the proceedings, have learnt that Mr. John West has recently been in America, and has returned much impressed by many things that he saw and heard there. In a little chat with him on his experiences, it was not surprising to hear that he was received by quite a number of the most prominent of American gas engineers in a kind and hospitable manner. Less prominent gas men than he have tasted of the *bonhomie* of our friends "across the stream;" and it was not likely that a man bearing a name that is a household word among British gas engineers would be allowed to knowingly pass through America without a hearty greeting. At Pittsburg, Mr. West met his old friends Mr. John Young and his brother, the Engineers in charge of both the natural and coal gas supplies of the town; and at Cleveland, among others, he saw Mr. Greenhough (formerly Engineer of the Boston Gas Company), who is known to a large circle of English gas engineers.

Regarding business matters, Mr. West was very favourably taken by the energetic methods employed for obtaining new consumers and extending the use of gas. He believes this special perseverance (which appears somewhat innate in the American) is necessary on account of the opposition which is set up in some of the large towns, there being in several cases triple competition—natural gas, coal gas, and electric light all severely contesting for superiority. Competition such as goes on in America could not, of course, take place in England, where gas companies are more efficiently protected by Acts of Parliament and Provisional Orders. Most of the largest coal-gas and oil-gas works in the principal States were visited by Mr. West; and he found that, in a number of them, oil gas is used as an auxiliary similar to the manner in which it is employed in England. In certain places, however, where oil gas is very largely in evidence, he gathered that, inasmuch as oil has become dearer, the engineers are inclined to turn their attention to the manufacture of coal gas, which, they appear to be of opinion, can be introduced and supplied in some of the cities at cheaper rates than the consumer is paying at the present time. As a gas engineer, Mr. West was also glad to find that a large number of gas-engines are being employed in many works as the motive power for working dynamos and other appliances. Cooking and heating stoves are also very much to the front; and they appear to be propagated among the consumers not only by the gas companies themselves, but by special outside companies, who, of course, receive the co-operation of the gas suppliers, and so both are mutually benefited. Altogether Mr. West seems to have had a good time in America; and to have returned from his trip renewed in vigour.

PERSONAL.

Mr. J. R. MACKENZIE has been appointed Gas Manager to the New Mills Urban District Council in succession to Mr. G. B. Smedley.

Mr. HUBERT RUSSEL, the Engineer, Manager, and Secretary of the Holmfirth Gas Company, has been appointed Engineer and General Manager of the Callao Gas Company, Peru; and when he sails for South America on the 3rd prox., we are sure he will take with him the good wishes of many friends this side. Mr. Russell (who was trained under his father, the Engineer and Manager of the Bexhill Water and Gas Company) was appointed Manager and Secretary at Holmfirth in 1898; and the following year he received the additional appointment of Engineer. Under his supervision, the works, which were in a very bad condition at the time of his appointment, have been brought up to date; and they are now in first-class order. Under these circumstances, it is not to be wondered at that the Directors are sorry to lose Mr. Russell's services, and that they have several times increased his salary in order to retain them.

OBITUARY.

We regret to learn of the severe bereavement recently sustained by Mr. T. NEWBIGGING by the death of his wife, which took place at their residence in Cheshire. Mrs. Newbigging had not been in good health for some time past, and had therefore lived somewhat in retirement; but she will be remembered by those of our readers who attended the meeting of the Gas Institute in Manchester in 1885, when her husband was President, for her share in the non-technical portion of the proceedings.

In the course of the proceedings at the recent meeting of the Gas Institute, the death of M. FRANÇOIS ALAVOINE, of Beauvais, one of the honorary members, was announced. Deceased occupied this position in virtue of being a Past President of the Société Technique du Gaz en France. He was born at Quimper in 1836, and studied first at the college in the town, and afterwards at Sainte-Barbe, in Paris. He entered the army, and was a captain of artillery at Grenoble; but, owing to his health, he left the service, and in 1866 became Manager of the gas-works at Beauvais. In the troublous times of 1870, he again took up the soldier's duties, and was seriously wounded, for which he received the cross of the Legion of Honour. He was connected, either as member or as Chairman, with several undertakings associated with the gas industry. He was President of the Société Technique in 1887, and of the Chambre Syndicate de l'Industrie du Gaz last year.

A Gas Fire Alarm.—At Cherryvale, in Kansas, there is a well of natural gas, with an extraordinary discharge estimated at 13 million cubic feet per diem. It was arranged so as to supply gas for heating, lighting, or motive power in a zinc-works where there are 300 workmen. The local fire brigade utilized the great pressure of gas for operating a siren, which can be heard some miles off, to give the alarm in case of fire.

The Universal Meter System was adopted last year by the Water Board of Lowell (Mass.), and the annual report furnishes some notes concerning the effect of metering tenements containing three or more families. Out of 425 meters set, 189 were using water at less than the faucet rate, and 236 were using more than they were paying for by rate. The total annual charges by rates for the 425 meters were $18,132. The first quarter showed a use of water valued at $35,345 per year; the second quarter, at $24,942; and the third quarter, at $15,589.

Tar for Surfacing Roads.—According to the "Revue Scientifique," coal tar has been successfully employed in surfacing roads for the prevention of dust in the department of the Haute-Garonne, as well as along the Chemin des Abattoirs at Monaco. Two months after the application of the tar, the road was found to be in perfect condition, and seemed to be capable of withstanding the effects of traffic. There were no accidents from horses slipping; the soil was of a greyish colour; and there was no odour or dust. The cost was the same as that given by Signor Rimini for his experiments in Italy—as already noticed in the "JOURNAL" (*ante*, p. 1024)—viz., 7½ c. per square metre.

Meeting of Dutch Gas Engineers.—The Association of Dutch Gas Engineers will hold their Thirtieth Annual General Meeting at Hilversum, on Wednesday and Thursday the 2nd and 3rd of July, under the presidency of Heer O. S. Knotterus, of Rotterdam. Among the private business to be transacted is the voting of a sum of money for the publication of a pamphlet on manuring with sulphate of ammonia. There are also to be elected two Editors of the official organ of the Association, "Het Gas," in the room of Heeren C. T. Salomons and P. Bolsuis, whose term of occupancy of the editorial chair will expire at the end of this year. A number of interesting points on the technique of gas manufacture are down for discussion, and, *inter alia*, Heer N. W. van Doesburgh, of Leyden, will make a communication on "suction" producer-gas installations. The place for next year's meeting has to be selected. In the afternoon of Thursday, the members will visit the Hilversum Gas-Works.

COMMUNICATED ARTICLE.

GAS MATTERS IN THE UNITED STATES.

The "Reform Administration" and the Price of Gas.

One of the special properties of this land (of little liberty and of much license) which the dear old country lacks, is the "Reform Administration"—that period of mighty promise and so small performance which follows as certainly upon the normal state of the administration of public affairs as does repentance and a headache after an orgie of any other sort. At the time of writing, this city, as may be you know, is enjoying or enduring such an experience. The administration has been reformed—that is to say, the citizens experienced an attack of sense of duty, a sort of virtuous headache, following much misbehaviour, or it may be a species of delirium. The question of the genuineness of this repentance has not infrequently been raised, quite often in fact, both by the outs (the leaders in the aforesaid improper conduct) and also by certain dissatisfied of the ins, who were convinced that they had been deceived by rash promises into voting for men who either would not or could not make good their promises.

Among the promises said to have been made by certain of these newly-elected ins—made, it was said, during the pre-election headache mentioned above—was one in reference to the price of gas. Sayings in reference to these pre-election promises have been in the air ever since the election, and much very funny talk has been indulged in. Finally, the campaign against the Gas Company was begun by way of the newspapers; and, as usual, they (the newspapers), posing as the natural and watchful guardians of the people, claimed the credit of a great discovery. Much after the manner of some half-civilised despotism, the papers preambled their account by some uncalled-for self-glorification as guardians of the people, and told how the candle power of the gas made by various Gas Companies in New York was being reduced. Reduced not below the standard required by law, mind you, but to that standard, or rather towards it; for the companies had been furnishing gas much above the standard candle power, in order to gain a certain popularity in the disputed territories in the Suburban parts of this great city, especially in the regions beyond, or contiguous to, the Harlem River districts—that portion of the island and the mainland which represents the city's sleeping rooms, speaking loosely. The fact of this reduction was announced with a great flourish of the tin horns of the political organs; and a campaign for the reduction of the price begun.

Save in their position as State-franchised bodies, the Gas Corporations held their peace. Not so the city's representatives, who, without hesitation, said their say and made many speeches and some threats about the punishment which should be inflicted, and which they surely would inflict, upon the wicked Gas Companies. The determination to punish the evil-doers finally took shape in a resolution to reduce the price of gas. To prepare for this, it was made clear that, candle power for candle power, London paid less than New York; and it was utterly outrageous that gas companies should reduce candle power and still not put down the price. Finally the machinery of civic legislation was set in motion to reduce by enactment, and to make the price of gas 80 cents (3s. 4d.) per 1000 cubic feet.

Fortunately for the dignity—trifling as that is—of the city authorities, after the plan was formulated, but before the enactment was finally voted on, some member, whose thinking machine was better regulated than that of his fellows, suggested the propriety of consulting the Law Officers of the city to know if this proposed scheme would have any result beyond making the city paters ridiculous. In due time the City Law Officers replied that the price of gas is not one of the things on which the City Fathers can efficiently legislate. So ends this comedy; and it ends with a strong suspicion that the "informers" knew all the time that such legislation was impossible, and that any attempt of this sort must assuredly bring them to an absurd *impasse*—that again the "informers" had made promises they knew they could not make good, simply to raise a popular outcry and to win votes at an election.

Fortunately, since they had such desires, they lacked ability to do; for this confiscation of franchise property by legislative act is altogether too common in this country, in which the popular opinion, as represented, or, more accurately, organized, by the newspaper men, is continually striving to compel the legislative bodies to attempt it. It is most fortunate that in this case they have failed, not only in their attempt on the gas companies' rights, but also in forcing the passing of a resolution voting the city government a set of fools on their own showing. The only part of the matter which is not yet understood to the satisfaction of the street, is how the City Fathers came to find sufficient good sense to ask if their "law" was lawful before they made it. It must have been sheer and simple luck that they did not go so far as to make themselves ridiculous in the sight of all men.

The "Beef Trust" and the Consolidated Gas Companies.

The notion that there can be any relation between the two business enterprises so far apart in one sense as these two—the furnishing of meat and that of fuel and light—seems far fetched; but if things keep on in the way they are going, we are very likely to see "some fun," as Kipling's heroes might express it, in the premises. Just as surely as the Packers' Association which it is now the fashion to revile and abuse, and against whom the powers of the various States are arrayed because they came to an agreement to cease their absurd rivalry and to conduct their business on business principles—just as surely as they are made the victims of this newspaper noise and clamour, just so surely will the turn of the Gas Companies come. Competition of the most cut-throat order was in vogue in several districts of the city only a short time since, for what purpose no one seemed to know, which competition came to an end by a working agreement between rival Companies, in just the same way—an agreement for a uniform price in some cases and withdrawal from disputed territory in others. This differs in no way from the practical working of the Packers' Association; and if such an agreement is unlawful for one, it is equally unlawful for the other—indeed, it is hard to see how any trade agreements of any sort can be made without offending against the Anti-Trust Law.

Good lawyers are expressing the opinion that if two or three firms should consult together about the price which should be charged for iron castings, then they also become subject to the same damnation. We have had one demonstration of how the Courts yield to popular feeling, in the old famous "cast-iron pipe cases," in which an agreement, "not in itself unlawful, was made so by the law of the land." During the past few weeks, I have questioned many men at the clubs, and have had the best of opportunities for finding out the notions entertained on this question. All the people I have been able to question may be divided into two classes—those who have a panic fear of "rings and combines," and those who regard the "unification of industries" as one of the necessary steps in the world's industrial evolution. This panic fear forbids anything at all approaching sane thinking and unbiassed observation. The simple fact that two firms ask the same price for the same article is an evidence of their dishonest association; and when they openly say "we have agreed to ask so much for the service," they cry "the Republic is in danger."

This much is certain, the tendency to concentration—to the formation of less numerous, but larger, powers in the commercial world—is everywhere in sight. We see it in every industry in this land, and as much in the gas industry as any other; and one cannot but wonder, as one sees the making of history, if he is not also seeing the repetition of the land hunger of the Frankish race a thousand years ago repeated in another field. At the same time, it must not be forgotten that the excentripetal forces are many and powerful, and that the anachronism called the Sherman Act is on the books, to be enforced, if they please to do so, by men who see fit to say that they believe in it, be that belief true or be it only pretended. The Beef Trust and the Gas Corporations are in the same boat; and if it was or is unlawful for the meat dealers to combine to protect themselves against dishonest retailers, then every combination to punish swindlers is equally a crime.

It may seem a far cry from one to the other of the two subjects which I have coupled here; but since the connection is logically so close—since both are combinations for self protection—the disposition to pose as a prophet and to say to-day the beef dealers, to-morrow the coal dealers, the day after the gas companies is irresistible.

The Coal Strike.

The anthracite strike is on. The foolish temporizing with evil, the playing at politics, the supercilious silence of the coal trade is at last bringing its own punishment, as it should. Why did not the coal operators, if they have any case, appeal from Philip drunk to Philip sober, why, when they yielded an inch two years ago, did they not appeal to the good sense of the public which buys their product, and warn them of the rebellious feelings of their men? Why did they pretend satisfaction with a scheme which they knew must sooner or later be turned down or prove their ruin? Did they not see that the giving of an inch would stand for the taking of a yard?

Just look at the demands of the miners, an increase of 20 per cent. in their wages, and, in effect, the management of the property to suit themselves. The demand is precisely the same as that in England; the miner to dance while the mineowner pays the piper—obviously, a thing which cannot be. As always is, and as always must be, in such affairs, the crowd went with the victors. At the last outbreak of disloyalty and disorder, the disorderly elements represented only about one-third of the miners, or maybe one-half; and although the mines were short-handed, they were able to work. The presidential election was at hand. The operators yielded all demands, in effect if not in form; and every one saw in it a substantial "Union" victory, specially as, although much violence had been done and much property was destroyed, the ring-leaders, who were well-known to all, went absolutely unwhipped of justice.

Note the result. To-day there are so few men loyal to their employers that the mines are perforce idle; only the engineers and sump men remaining true to their salt, and these, utterly unreliable, may at any moment join the ranks of disorder. To this they may be lead either by fear of the riotous element from which no one is in position to assure them protection, or it may be from distrust of their employers, who, on the last occasion, rewarded their loyalty with empty words. Should the miners but be orderly during the first few days, and the operators and

authorities remain indifferent, no man can say what mischief may follow—follow from two causes, which one is almost inclined to believe the operators have either overlooked or undervalued. The first of these causes is the umbrage which Senator Hanna and his Arbitration Committee are said to feel at the mine-owners who have treated them, not as peace makers, but as the true leaders of the strike. These men will greatly influence public opinion and even executive action. The second of these causes is the influence of the Press, which is partly inclined to side with the miners for the sake of sales, partly for party reasons (the snub to Senator Hanna on the Republican side), and partly to bring votes to the Democratic ticket on the other. The influence of the prestige of victory also brings recruits.

Another influence for evil is the "Anti Trust" agitation. There is no doubt in any one's mind that the anthracite trade is "Trust ridden" to the last degree; and under this conviction—the conviction which in a way makes every voter hold a "Trust" an outlaw—violence will surely be attempted under the influence of the propaganda of disorder. Already for some weeks men have been exciting the Poles and Italians to disorder; the argument being "if they did not dare to punish us last time when the Government was with them, surely they will not dare to punish us now when the Government is with us and against them." The argument which called out the proclamation of the three tailors is also moving them—"we, the people, decree," &c. Again the notices of confiscation for their benefit is rife. My information is not hearsay nor by way of the Press; it comes from listening with my best attention to the oratory of their leaders.

Four weeks ago, I listened to an orator exciting the men to take the law into their own hands; and I noted the effect produced. One man said: "We are the majority, why should we not elect men who will execute the laws as we see fit? Let us elect the Governor and Legislature as we (*sic*) did in Illinois. The men who have urged to let us have our rights are the President's party, and he will not be so anxious to send troops to shoot us as was Cleveland to send soldiers to Chicago." The wild cheering showed that the argument had gone home; and there is no question but that the element most given to disorder believes that it is free from all interference from the Central Government—a condition which is hardly conducive to peace and quiet.

Another element which makes for disorder, although no one can tell to what extent, is the division of the miners into three camps, each more or less hostile to the other two. One camp may be called the Germanic, as in it are found the few English, Americans, and Germans, together with the English speaking Irishmen. The other camp is that of the "Hunks" and the "Hikes" as the English speakers effect to call the Hungarians and their allies, and the Italians and the Scicilians, with some Frenchmen, respectively. While these two camps are now allied in warfare against their employers and law and order, they are mutually antagonistic on nearly all occasions.

The Strike and the Gas Companies.

Turning aside from this so dark and melancholy outlook, we can see a much brighter outlook—the promise of greater trade to the gas companies, and, incidentally, to the coke companies as well. Every pound the less in the supply of the anthracite mines must be made up either by gas coke or by gas; and it requires but a few dollars increase in price per ton of anthracite to bring the coke into the market as the proper fuel for domestic uses, and but little more to bring in the gas-stove. And when the gas-stove has come, it has come to stay. It must be always remembered in considering the New York and Boston markets—and, in general, all the markets in New England—that it is an eleventh link in the chain of the decalogue "Thy chimney shall not smoke; and whosoever has a smoky chimney shall be brought before the Magistrate and fined, and afterward shall suffer social loss of prestige." Under these conditions, ordinary soft coal, burned in the ordinary way, will not be considered satisfactory fuel, even for a day. To meet the want of the anthracite, only two things are possible, coke and gas—coke for the kitchen range, and gas for other rooms and uses. In view of this fact, the present strike, like the last one, will do the anthracite coal operators, real and actual, unquestionable harm. But it will not really help the anthracite miners. On the contrary, it will throw business into the hands of the bituminous mines, which the anthracite mines and miners will in vain seek to regain. When the strike is over, the price of anthracite coal must inevitably be higher, and, to some extent at least, the use of coke will remain—partly as a fuel of choice, and partly because of its cheapness as compared with hard coal. This, in turn, will react on the price of gas, tending to bring it still lower, and thus increase the consumption; so that, little by little, we shall find that coke and gas are supplanting anthracite coal for every use. When we stop to consider that, ton for ton, the number of B.T.U. to be obtained from one ton of gas coke is just the same, neither more nor less, than may be obtained from a ton of anthracite coal—assuming that the values given in "Poole on Fuels" are correctly stated—there is no reason under the sun why the gas coke should not find its market for the heavy work and the gas for lighter uses. This would surely solve the problem, and that in the most satisfactory fashion. The only question remaining would be, Is there enough of a market for all the products to make it pay? The answer is obvious. If the heating power of gas coke is the same as anthracite coal, then the price should be the same. Both are smokeless, and must be counted in on the same basis.

TECHNICAL RECORD.

MANCHESTER AND DISTRICT JUNIOR GAS ASSOCIATION.

Visit to the Leigh Gas-Works.

The Monthly Meeting of the Association held last Saturday took the form of a visit to the gas-works of the Leigh Corporation. The party were received by Alderman H. Cowburn, Chairman of the Gas Committee, Mr. T. Holt, Deputy Town Clerk, Mr. John Foster, Engineer and Manager, and various members of the staff. About an hour-and-a-half was spent in inspecting the various portions of the works and plant; the special features of which were lucidly explained by Mr. Foster and his assistants. The new purifier-house, which was described and illustrated in the "Journal" for the 15th of April last, attracted particular attention; and the governor and meter houses and the chemical laboratory also afforded matter of interest as examples of the up-to-date character of the works. In the article above referred to, pretty full details of the recent extensions carried out by Mr. Foster were given; but, as showing the growth of the undertaking since he became Manager five years ago, it may be mentioned that during this period the consumption of gas has increased from 100 to 150 millions. There are about 5800 consumers; and within the last three years the Commitee have put in some 2300 cookers and 750 grillers. It will thus be seen that the hiring out of cookers and grillers has become an important part of the Committee's undertaking. The increase in the consumption of gas last year was about 5 per cent., and, as we understand, it was almost entirely attributable to the extended use of cookers and grillers—the ordinary consumption for lighting purposes being practically unchanged, owing, it is assumed, to the increased adoption of incandescent lights.

After the visit, the members were entertained to tea, at the close of which,

Mr. F. Thorp proposed a hearty vote of thanks to Alderman Cowburn, the Gas Committee, and Mr. Foster for allowing the members of the Association to go through the works. The good attendance, he said, amply proved that the members were really interested in the visits to gas-works which were from time to time arranged, which were of the greatest benefit. It was very gratifying to find men like Mr. Foster taking an interest in the junior engineers, and they were greatly obliged to him for his kindness in explaining the various points of interest in the works.

Mr. Hill, in seconding the motion, said he thought the idea of trying to arrange a visit to the Leigh Gas-Works was due to his recommendation. He had suggested that if they wanted to see an up-to-date works, particularly as regards the purifying-house, they should visit Leigh; and he thought all would agree that they had that afternoon seen one of the most modern purifying plants in the district.

Alderman Cowburn, in responding, remarked that it had given him great pleasure to welcome the Association. With regard to Mr. Foster's management. few of them knew what the works were like when he came; but they could see what they were now. A thorough transformation had taken place; and he thought this had been for the best. The last extension that had been carried out was the new purifying-house; and they would have seen that this not only provided for present wants but would be adequate for a good many years to come. He was very glad to see the members there, especially for one reason. Most of the good things they had at Leigh were copies of what Mr. Foster, or he and his Committee, had seen elsewhere. They went, saw, and, if they could, improved; and, having done so, they were quite willing that other people should copy them.

Mr. Foster also responded; and, in doing so, said that in forming the Association the members had done a very good thing for the gas profession. Had it been formed earlier, there was no doubt he would have taken the first opportunity of joining it, because he thought they had in an Association like that the finest means of learning they could get hold of. By arranging visits to works, as they did, they were doing the best thing they could for themselves in the way of extending their knowledge of, and insight into, the details of gas-works practice. He had been very pleased to receive the members that day, and thanked them sincerely for their visit.

Presentation to Mr. S. E. Halliwell.

A pleasing feature of the afternoon's proceedings was the presentation to the President, who has recently entered the married state, of a smoker's cabinet, suitably inscribed, and an afternoon tea-service for Mrs. Halliwell. In the unavoidable absence of the Vice-President (Mr. C. Berry), Mr. Garlick made the presentation. He said the Council's proposal to offer Mr. Halliwell some token of the respect in which he was held had met with a very hearty response from the members. They looked forward to their worthy President ascending higher and higher in the profession. They had bought for him a smoker's cabinet; and as, after purchasing it, they had still a balance in hand, they had utilized this by obtaining an afternoon tea-service for Mrs. Halliwell. He had great pleasure in asking their President to accept from the members these tokens of their regard. The

President, in acknowledging the presentation, said his vocabulary was altogether inadequate to duly express his appreciation of their kindness and the good wishes to which Mr. Garlick had given utterance. He should always look upon their gift with a great deal of pride, and it would arouse in him pleasant memories in connection with the Association. He was sure they would all agree with him that the Association had justified its existence. Its value was to be seen in many directions. In the last examination in "Gas Manufacture" there were 152 passes, as against 115 in 1901, and 64 in 1900. He did not wish to claim too much for the Association, but he thought this increase was, at any rate, partly due to it. It was, he thought, owing to the Association that the authorities of the City and Guilds of London Institute had been prevailed upon to extend the time of the examination from three to four hours; and it was not assuming too much to infer that the increase in the number of passes was partly due to this fact. He was also proud to note that four of their members had been elected members of the Incorporated Gas Institute at Southampton, and one had been elected an associate. These things spoke very highly for the value of the Association's work. In conclusion, he again expressed his sincere thanks for the kindness of the members. He was glad to know that any work he had done in connection with the Association had been appreciated; and he assured the members that they would have his hearty co-operation in the future.

WATER GAS MANUFACTURE IN THEORY AND PRACTICE.

By Dr. James Kramers.

[Abstract Translation of a Communication published Last Year in "Het Gas."*]

(*Continued from p.* 1567.)

The "Run."

As already stated, the combustion of C may take place in two ways—namely, to CO and to CO_2. Experience shows that, so long as the temperature of the fire is low, there is much CO_2 in the products of combustion, while at a high temperature, chiefly CO is produced. A theoretical question, difficult to answer, is whether C is first consumed to CO according to the equation $2C + O_2 = 2CO$, and the CO afterwards consumed, to a greater or less extent, to CO_2 according to the equation $2CO + O_2 = 2CO_2$, or whether C is consumed direct to CO_2 according to the equation $C + O_2 = CO_2$, and whether the appearance of CO must be explained as a reduction effect according to the equation $C + CO_2 = 2CO$? The result is in both cases the same; and according to both views the presence of CO and of CO_2 in the products of combustion is explained.

Lang indicated, in his article already quoted, that he had succeeded in obtaining CO_2 exclusively on passing O_2 over C at a low temperature; and he thought he could conclude that this CO_2 was directly formed because the experiments had been made at so low a temperature, that CO under those conditions would not be consumed to CO_2. He passed a mixture of 77·7 per cent. of O_2, 18·5 per cent. of CO, and 3·8 per cent. of N_2 over carbon at different temperatures and at different velocities, with the following results: In the first two experiments, at rates of passage of 100 c.c. in 120 and 150 minutes respectively, and at 500° C, no change took place in the proportion of CO; while all the oxygen was changed to CO_2. In the next three experiments, the mixture was passed through at rates of 100 c.c. in 1 and $\frac{1}{3}$ minute respectively, or much more quickly, but at about the same temperature, and the percentage of CO increased to about 25. In the subsequent experiments, the proportion of CO decreased because of either the higher temperature (703° to 734° C in two experiments) or quicker passage of the gas (100 c.c. in 5 to 30 seconds, resulting in temporary rises in temperature, in six experiments at about 500° C.). For these reasons, the CO was hot enough to be consumed to CO_2. It would therefore be necessary to suppose that in experiments 1 and 2, either all the CO passed through unaffected, or else was consumed to CO_2, while there was formed, according to the equation $2C + O_2 = 2CO$, exactly as much CO as had been consumed.

The latter assumption is of itself very improbable; but it becomes still more so on considering that, if the temperature was high enough to consume the CO (which was originally present), it was also high enough to consume the CO which was formed. Therefore, it would have to be assumed that precisely as much CO was set aside before combustion as there was originally in it, seeing that at this low temperature no CO_2 could be reduced to CO, as was shown by tests. The most reasonable explanation therefore is that the CO remains unaffected. But then it follows that no CO has been produced; for otherwise at this temperature the proportion of CO must have increased. We should thus follow Lang in assuming that at a low temperature CO_2 is always formed directly; and as there is no reason to suppose, failing proof to the contrary, that at a high temperature anything else would happen, the same can be assumed for high temperatures, and the occurrence of CO explained by a secondary action—namely, the reduction of CO_2 by C, according to the equation $CO_2 + 2C = 2CO$. This reaction has also been separately observed, as already stated earlier.

This view is, however, not shared by Professor Vivian B. Lewes. "All such theory is now changed,"* he asserts; and then he boldly adds "the work of Dixon, Baker, and others shows us that the direct combustion of carbon with oxygen yields only one oxide (CO), and that this is the primary product of combustion, while this CO, in contact with oxygen or any oxydizing substance, forms CO_2. . . . At the present time, we know, that, as long as there is no air in excess, CO can be the only product of the action." A little further on, Lewes follows with an, if possible, still stronger assertion: "Our ideas," he says, "about the origin of water gas are modified. The formation of CO_2 in the water gas has always been explained by the assumption that there is a variation in the actions which take place according to the temperature of the fuel, and that at high temperatures the decomposition of the steam may be represented as $H_2O + C = CO + H_2$; while as the temperature of the fuel bed falls, the action approximates more and more closely to $2H_2O + C = CO_2 + 2H_2$. This view is, however, incorrect; and the CO_2 is not formed by the action of steam directly on C, &c."

The author must advise Professor Lewes to read the well-known treatises of Naumann and Lang. He would then probably come to other opinions. Seeing that Lewes furnishes no iota of proof, the author considers that he has sufficiently refuted him by what has already been stated about the direct formation of CO_2 from the action of H_2O on C. The assertion of Lewes is, so far as it extends to temperatures below 600°C., decidedly wrong; and for higher temperatures, it cannot be supported by a single positive argument. It is necessary to protest against these words of Lewes. He instances no experiments of his own on the question, but refers to Dixon, Baker, and "*others*;" and, lastly, he finds in the Dellwik apparatus a beautiful exemplification of the new theory. The latter is decidedly unintelligible, and will be returned to later, after the evidence relied on by Lewes has been reviewed.

As regards the "others," they may be left to be accounted for by Lewes, as, according to Dixon, only the researches of Lang and Baker come into consideration.† Lang's conclusion is, as stated, exactly opposed to Lewes's assertion. There remain then Baker and Dixon. Of Baker nothing is known but an article in the "Philosophical Transactions" for 1888, Vol. 179, A, pp. 571-581. A review of Baker's experiments will be given directly. As regards Dixon, several articles by him have appeared on the subject. Baker's experiments are briefly:

1.—He passed carefully dried oxygen at a *red heat* over carbon, at a fairly high speed. He obtained a mixture consisting of 5 per cent of CO_2, 40 per cent. of CO, and 55 per cent. of O_2.

2.—Having dried the oxygen still more carefully, he passed it over carbon heated to a white heat. He then found 2·2 per cent of CO_2, 39·5 per cent. of CO, and 58·1 per cent. of O_2.

Baker finds these results very striking, and afterwards says they appear to show that carbon is first consumed to CO, and that this afterwards furnishes CO_2, unless the formation of CO_2 occurs through employing very dry oxygen.

3.—Another time, at a red heat, he obtained 1·7 per cent. of CO_2, 27·8 per cent of CO, and 70·5 per cent. of O_2.

4.—He passed air over carbon at 500°C., and found 88·2 per cent. of CO_2 and 11 per cent. of CO (taking $CO_2 + CO$ as 100).

When he repeated this experiment at a somewhat lower temperature, he found 82·1 per cent. of CO_2 and 17·8 per cent. of CO, and at 400°C., 63·24 per cent. of CO_2 and 36·76 per cent. of CO.

5.—Passing air through a U-shaped tube, filled with carbon and suspended in vapour of boiling sulphur (440°C.), he found 57·28 per cent. of CO_2 and 42·72 per cent. of CO. On passing it through more quickly, he found 60·86 per cent. of CO_2 and 39·14 per cent. of CO; and, passing it through still more quickly, 46·81 per cent. of CO_2 and 53·19 per cent. of CO.

6.—Lastly, he passed a mixture of 15·4 per cent. of O_2 and the rest of the nitrogen over heated (? how highly) carbon, and found 33·4 per cent. of CO_2 and 66·5 per cent. of CO.

These are Baker's chief experiments; and at the end of his treatise he says: "As we now find that when the conditions under which the experiment is made are more and more unfavourable for the oxidation of the CO—viz., [1] By lowering the temperature (experiment No. 4); [2] by reducing the proportion of oxygen to nitrogen (experiment No. 6); and [3] by drying the oxygen completely—and the more slowly the more CO is found, are we consequently not justified in assuming that the combustion of carbon primarily produces CO"?

Baker is thus very modest. He merely asks: Cannot the direct formation of CO be deduced from the result of my experiments? To this the author answers equally modestly that he

* The author has used throughout chemical symbols in place of the names of elements and compounds; and though such use is open to serious objection, and is contrary to our usual practice, it has been retained *for the sake of brevity* in this translation.—Ed. J.G.L.

* "Journal," LXXV., p. 1195. † Jour. Chem. Soc., LXXV., p. 631.

"thinks not," and for this reason. Baker takes for granted that CO is formed first, and then gives some reasons why he does not obtain CO exclusively, but the latter mixed with a larger or smaller quantity of CO_2. If we reverse the matter and assume that CO_2 is formed first, then from the same experiments of Baker, reasons can certainly be found to explain why he did not find CO_2 exclusively. Using as far as possible the same words: "As we now find that when the conditions under which the experiment is made are more and more unfavourable for the reduction of CO_2—first, by lowering the temperature (see experiments Nos. 1 and 2); secondly, by reducing the proportion of oxygen to nitrogen (by which there is less chance of local rise in temperature, see experiment No. 6); and thirdly, by passing it through more slowly (which, likewise, leaves less chance for local rise of temperature, see experiment No. 5), and the more slowly the more CO_2 is found—are we not justified in assuming that the combustion of carbon first forms CO_2. This is not given as a convincing argument; but it is at least as good as Baker's, and therefore Baker's experiments certainly do not settle the matter."

This is also the opinion of Dixon, who says of Baker's experiments: "These experiments do not decide the question;" and the reason is very simple, and has already been hinted at. Baker, in order to obtain CO, heated the carbon so much that a reduction of CO_2 already formed could very well take place; and when the temperature was lower (400° C.) and CO still appeared, a local heating could without difficulty be explained from the heat liberated by the reaction $C + O_2 = CO_2$.

We think Baker's experiments (especially those in which the oxygen was so carefully dried) likewise "very striking"; but not so much because he found CO where he expected CO_2, but rather on account of the peculiarity that perfectly dried oxygen appears to combine so badly with carbon, and a trace of moisture has such great influence. This, however, does not concern the water-gas question, seeing that air is always employed. Dixon agrees that the facts observed by Baker are easily explained on the assumption that CO is first formed, yet, just before, he says precisely the same of Lang's opinion and experiments. Lang's experiments, however, are distrusted in regard to accuracy and completeness by Dixon, who has subjected them to a strict examination, and repeated them under somewhat modified conditions. Even after giving the result of his experiment, he writes these words (which Lewes certainly has not read): "It must be admitted that a decisive proof is still required."

After this, it will certainly not be necessary to consider Dixon's experiments more closely. In Dixon's own view, they are not conclusive. They will be described briefly here, more especially because, as will appear directly, one experiment, although undertaken to show that C is consumed directly to CO, on the contrary furnishes the best proof that C is consumed directly to CO_2. Dixon's experiment, by which he expected to upset Lang's argument that CO_2 is formed at a temperature at which CO would not be consumed to CO_2, will be first considered.

Dixon passed a mixture of O_2, CO, and N_2, over coke at 450° to 500° C., and obtained quite different results from Lang. He found always—he cites three experiments, though he made more than 100—that the percentage of CO, both with very slow or very quick rate of passage, was lower than the original quantity; whilst at intermediate rates of passage a certain maximum for the proportion of CO appeared, which was higher than the original quantity. This series may serve as a type. The original composition was: 76 per cent. of oxygen, 23·40 per cent. of carbonic oxide, and 0·60 per cent. of nitrogen.

Action of a Mixture of Oxygen and Carbonic Oxide on Coke at 450° to 500° C.

No.	Percentage Composition of the Products.				Time in which 100 cc. were collected.	Remarks.	
	CO_2	CO	N_2	O_2			
1	91·8	7·3	0·9	—	2 hours	Carbon remained dark.	
2	91·2	8·1	0·7	—	1 ,,	,, ,,	,,
3	88·5	10·9	0·6	—	35 min.	,, ,,	,,
4	76·8	21·8	0·8	0·6	6 ,,	,, ,,	,,
5	72·2	26·3	0·8	0·7	3 ,,	,, ,,	,,
6	77·4	19·9	1·3	1·0	45 secs.	,, ,,	,,
7	94·8	2·8	1·2	1·2	18 ,,	Carbon glowed.	Blue flame.

It is difficult to agree with Lang, after this experiment, that when CO is passed through slowly, it remains unchanged; and as his reasoning rested on this, his argument becomes very weak. It is, however, also difficult to explain this experiment on the supposition that CO is always formed first, and therefore to look upon the 90 per cent. of CO_2 which is sometimes found as a combustion of CO. Moreover, the experiment was only undertaken to shake Lang's argument; and that is attained. Dixon did not wish to prove anything further.

And now to Dixon's most important experiment, by which he sought to furnish a positive proof in support of the view that CO is formed directly from C and O. He first shows that if pure oxygen is passed over heated carbon—assuming that combustion takes place, either to CO or to CO_2—there always arises a local heating of the carbon, which first comes in contact with the oxygen. This heating is so great that the CO formed is heated sufficiently to consume to CO_2 in the presence of oxygen; while the CO_2 is reduced to CO in the presence of C. There is thus raised a question, which can never be solved in this way.

This view of Dixon's is perfectly correct; and therefore the direct formation of CO_2 cannot be deduced with perfect certainty, even if CO_2 exclusively is found—as Lang in fact did find—neither can the direct formation of CO be deduced if CO exclusively has once been obtained (which, however, has not been done). Dixon then had the idea of mixing the oxygen with so much inert gas that no rise in temperature occurred, even when the carbon was all consumed. He found that if he used a mixture of about 8 per cent. of oxygen to ± 92 per cent. of other gases (carbonic acid and nitrogen) no rise in temperature occurred, if this mixture were passed through a tube filled with carbon and previously heated to 500° C. Dixon argued that if a formation of CO then took place, CO must be formed direct, as at 500° C. no reduction of CO_2 takes place.

This is quite true; but Dixon omitted to say that this reasoning can also be applied to CO_2, and it may be said with still greater justice that if no formation of CO_2 then takes place, CO_2 must be formed direct, as at 500° C. no combustion of CO to CO_2 takes place. This can be said with greater justice for two reasons—viz.: (1) Because the temperature at which CO is consumed to CO_2 is higher (between 650° C. and 730° C.) than the temperature at which CO_2 is reduced by C (± 600° C.). (2) Because much less heat is liberated on the formation of CO than on the formation of CO_2, and therefore (*vide* "1"), much less chance exists for local heating on the formation of CO (in consequence of which local heating CO might be heated high enough to be consumed) than can exist on the direct formation of CO_2 for local heating to occur high enough to reduce the CO_2 under the influence of C.

The conclusion to be drawn, therefore, is that it would not be surprising—supposing that CO_2 is directly formed—that a trace of CO should appear, but that it is highly improbable that CO_2 would be found under the given conditions, if it is accepted that CO is always the primary product. This is what Dixon found:

Composition before the Experiment.				Time in which 100 cc. were Collected. (Minutes.)	Composition after the Experiment.				Increase of CO_2.	Proportion of the Increase of CO_2.
No.	CO_2.	O_2.	N_2.		CO_2.	O_2.	CO.	N_2.		
1	90·8	7·7	1·5	3	97·3	0·0	1·0	1·7	6·5	6·5
2	90 8	7·7	1·5	5	97·5	0·0	0·8	1·7	6·7	8·4
3	89·0	8·4	2·6	7	96·5	0·1	0 8	2·6	7·5	9·4
4	89·7	8·5	1·8	9	98·0	0·1	0·5	1·4	8·3	16·6
5	91·0	8·1	0·9	30	98·0	0·1	0·2	1·6	7·0	35·0
6	89·6	8·4	2·0	50	98·1	0·1	0·2	1·6	8·5	42·5
7	89·9	8·3	1·8	65	98·2	0·1	0·1	1·6	8·3	83·0

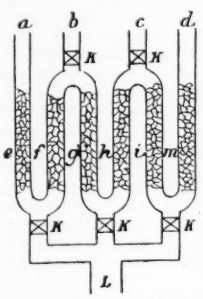
It is apparent from this that the increase of the CO_2 on quickly passing the gas through is 6·5 times greater than the increase of the CO; and on slowly passing the gas through, 83 times greater. What it would be if the gas were passed through still more slowly, may easily be surmised. The quantity of CO that can be substantiated on the slow passage is so small that it may be an error of observation; for the error made in experiment 6 in the determination of nitrogen was 4 times greater. Considering that, according to the idea of the direct formation of CO, absolutely no increase of CO_2 could have been substantiated, and CO might have been the chief, and perhaps the only, product, it follows from the above experiment that this idea is untenable. It necessarily follows that the direct formation of CO_2 from C and O_2 may be accepted. Dixon may therefore be thanked for his experiment, which so unexpectedly supported this idea.

We have still to finish with Lewes. "The Dellwik process has come at a moment," he says, "when the general views as to the actions taking place during the combustion of carbon are undergoing a radical change"—we know now what we have to think of this!—"and no better example could be found to illustrate these views than the cycle of operations taking place in the generator during the two processes of blowing and steaming." These words are remarkable, as Lewes asserts that CO exclusively is formed, if care is taken that there is no excess of air. It would then be thought that the Dellwik apparatus would be given as the type in which this takes place. With the Dellwik apparatus, however, it is just the reverse, as there, according to Lewes, CO_2 alone arises; but if that is so, how can the Dellwik apparatus be a good example for the elucidation of Lewes's idea? This logic gives us pause. It would appear that the old generators, in which, as Lewes asserts, CO alone arises—which, however, is not true, for CO_2 is never entirely absent—would be a far better example to elucidate Lewes's so-called new views.

Let us see what Lewes says to explain the percentage of CO_2 in the Dellwik apparatus. He says: "In the Dellwik plant, the air is kept always in excess, so that as the CO is formed, there is always sufficient oxygen present to oxidize the CO to CO_2." It will be asked, would not that excess not also be there at the moment that the air first comes in contact with the fire? There must be an excess of air *then*, for the medium is then air alone, while higher up the medium is a mixture of air, CO, and N_2 (and CO_2); and as in all generators there is always a place where the air first comes in contact with the fire, therefore in all generators also CO_2 must be formed, even if it is later again reduced. Lewes's explanation is thus worthless, more especially because his

idea that $C + O_2 = CO_2$ never takes place directly, certainly finds no support in the example cited of the Dellwik generator. In conclusion, the author maintains that, with the hot blast, $C + O_2 = CO_2$ first occurs, and afterwards, higher up in the generator, $C + O_2 = 2\ CO$.

In what way can it be arranged that CO_2 shall be as far as possible the final product? As already stated, the reaction $C + CO_2 = 2\ CO$ is a reaction dependent on the temperature, and on the length of the layer of carbon traversed. As to temperature, there is no choice; but during the blow it is the aim to attain the highest possible temperature. There remains then the length of the layer of carbon, which is partly under control. During the blow, it should be possible to divide the layer of carbon into several short layers, and bring these together again during the gas-making (as then a long layer is desirable), as shown approximately in the annexed figure. If the five cocks K are opened, and the air enters at L, it breaks up and passes through the six short layers—*e*, *f*, *g*, *h*, *i*, and *m*—and escapes at *a*, *b*, *c*, *d*. The CO_2 formed will then have but little chance of being reduced to CO. If during gas making the cocks K are closed, then, if steam is let in at *a* and the gas taken off at *d*, or *vice versâ*, the steam must pass over a long layer of carbon.



There is also another means—viz., increasing the rate of flow of the air introduced, so that the CO_2 would then be a shorter time in contact with the incandescent carbon. Thus an increase in the rate of flow has just about the same effect as a shortening of the layer. By combining and applying these two means at the same time, the proportion of CO will be decreased still more; but the so-called producer gas, or blow gases, will never be entirely free from CO. There is yet a third means of acting on CO_2—namely, after the reaction $CO_2 + C = 2\ CO$ has started, to consume the CO formed again to CO_2, by the introduction of secondary air. The heat thus liberated naturally cannot go directly to help the fire; but it can be stored in regenerators, and thus be utilized for the process. Using the heat of the blow gases—which, according to this arrangement, will consist almost entirely of CO_2 and N_2—to warm the air which is to be used for the blow, will cause the temperature of the generator to rise still more. The calories, moreover, which otherwise would be lost with the blow gases, will still be used for the purpose in view—viz., "the obtaining of a high temperature in the generator with the smallest possible consumption of carbon"—the ideal condition for gas making.

If the heat is withdrawn from the blow gases to such an extent that they escape at a temperature of $\pm$ 200° (which can, in fact, be done), then during the run about 92½ per cent. of the calories which the carbon consumed contained will be utilized. Then if air and carbon at 0°C. are supplied, it follows that

$$C + O_2 + 3{\cdot}7619\ N_2 = CO_2 + 3{\cdot}7619\ N_2 + 97{,}644,$$

and as the CO_2 contains $200 \times 10{\cdot}8 = 2160$ cal., and the N_2 $3{\cdot}7619 \times 200 \times 6{\cdot}83 = 5139$ cal., the products of combustion will carry off 7299 cal., and there remain $97{,}644 - 7299 = 90{,}345$ cal. behind in the apparatus—partly in the fire and partly in the regenerators—and this is really: $\frac{9{,}034{,}500}{97{,}644}$, or $\pm$ 92½ per cent. This figure could be further increased only if it were possible to take off the products of combustion at a still lower temperature, which can certainly be done; but the apparatus for the purpose (regenerators and recuperators) would be too costly.

[The foregoing concludes Dr. Kramer's study of the theory of water gas manufacture—the theoretical basis on which the plant should be designed. He adds a detailed description of the type of apparatus he prefers; and this will be given in a subsequent issue of the "JOURNAL."]

Outside Gas-Cocks in Fires.—In view of the recent serious and fatal fires which have occurred in the Metropolis, the British Fire Prevention Committee, of which Mr. E. O. Sachs is Chairman, have formed an Industrial Section, by means of which business men in the Metropolis will be able to avail themselves of the Committee's work. The object of the new section will be to disseminate literature bearing generally upon the prevention of fire in factories and works, together with leaflets giving advice upon specific subjects. One of these deals with night repairs and cleaning; and another strongly advises the use of outside cocks on the mains by which premises are supplied with gas. It is recommended that every such cock should be fitted to each building or block in such a manner that it can be easily worked by a key, and should preferably be placed on the wall of the main front of the premises in a suitable box in a position shown on a suitable plate. An indicator should be provided to show if the cock is on or off. The cock should be worked at least once a month by the responsible lamp-man of the establishment, or by the watchman or fireman in charge of the premises. Several large firms are availing themselves of the Committee's services under the new section.

CORRESPONDENCE.

[We are not responsible for opinions expressed by correspondents.]

The Economy of Gas-Engines.

SIR,—Perhaps it will interest some of your readers to learn that for the last two months I have been running two gas-engines (8 and 10 horse power) with blue water gas; and although I am at present unable to give the results of very accurate brake-horse-power tests, I find that the same engine, under exactly similar conditions, and performing the same duty in each case, will consume 100 cubic feet of coal gas, or 160 cubic feet of blue water gas. I cannot agree with Mr. Clerk as to the cost of blue water gas being much more than Dowson gas at 2d. per 1000 cubic feet. With the Dellwik-Fleischer water-gas plant, we are producing gas of double the calorific value of Dowson gas at 4d. per 1000 cubic feet; and I suppose, in any such comparison, some allowance would have to be made for the cleanliness of the water gas and the proportionately smaller engine required.

Ilford, June 20, 1902. J. H. BROWN.

The De Laval Turbine.

SIR,—It was with a great deal of interest that I read Mr. Child's paper to the Gas Institute on "Steam-Turbines as Applied to Blowing and Exhausting Apparatus;" and some of the members of the profession may like me to give, in a few words, the result of my own investigation of the turbine.

About three years ago, one of the leading Swedish engineers—and, I think, a gentleman who was interested in the manufacturing Company—placed the matter before me. At first, I thought it was ideal for the running of dynamos, blowers, or any class of machinery requiring high speeds. After learning all I could from the representatives of the Swedish manufacturers, I consulted one of the leading electrical experts of the world, who had experience with the turbine for running dynamos in America. I was referred to Professor W. C. Unwin, who had seen the turbine in operation at the World's Exhibition in Chicago, and had installed one in his shops at the Technical College in Kensington. He kindly showed it to me, and gave me the results of his own investigations. The turbine seemed to be (one might say) ideal, and perfect in every respect; and had my conclusions been based only on this one, I should unhesitatingly have recommended it, and adopted it in the work we have carried out.

I found, however, that—for reasons entirely unknown either to the manufacturers or to the operators—they were not all to be relied upon. Take, for instance, several manufactured and tested under precisely the same conditions at the shops, all of which had proved efficient, yet after leaving the works, and being used in actual practice, some of them would prove satisfactory, and others would give out. Owing to this unreliability, we decided not to replace the ordinary engine with them.

Commercially, the cost of installing the De Laval turbine is about the same as the cost of fixing the steam-engine; if anything, slightly in favour of the turbine.

In order not to mislead anyone, it is possible that, in the period intervening since I investigated this subject, the manufacturers have succeeded in overcoming some of the difficulties leading to the troubles that were experienced at that time.

19, *Abingdon Street, S.W., June 18, 1902.* J. T. WESTCOTT.

South Metropolitan Profit-Sharing Scheme.

SIR,—The enclosed resolution was unanimously passed at our last Profit-Sharing Committee meeting held on the 28th ult. I am pleased to inform you that the Board accepted it, and ordered it to be entered on the minutes of the Company. I ask you, Sir, if you will kindly insert the same in your next issue.

Thanking you in anticipation; also adding our thanks to you for the many articles that have appeared in the "JOURNAL" advocating co-partnership, which we believe to be based on sound economical conditions.

South Metropolitan Gas-Works, Old Kent Road, S.E., June 19, 1902. H. MANLY, Chairman, Workmen's Committee.

[ENCLOSURE.]

George Livesey, Esq., Chairman, South Metropolitan Gas Company, S.E.

DEAR SIR,—At a time when so much is heard of combination by employers and by employed, and when social and industrial questions are so prominent, the importance attached to these combinations and questions by all taking interest in the world around them is manifestly not to be ignored.

But while so much has been said, you, Sir, have acted and have initiated, and with the co-operation of the Directors have successfully carried out, during the last twelve years, a system for bringing together in this Company capital and labour to their common advantage.

It is therefore a pleasure, and the moment is opportune, to refer to the Company's profit-sharing system—this co-partnership of employer and employed—this desire by the employed for the Company's prosperity, united with anxiety by employer to increase the happiness and comfort of each individual connected with the Company, by giving additional opportunity for better conditions of living and work beyond the advantages enjoyed from constant regular employment with pay standing well by comparison with similar work elsewhere, special advantages as to holidays, paymen during sickness, and provision for advanced age.

By this profit-sharing system, men who are willing and capable secure a share of the profit they make; and, although none are compelled to take part in it, all are free to participate. By far the larger portion of the employees elect to be profit-sharers, and many have allowed their bonuses to accumulate, and have even increased their amounts with the Company by additions from their wages. The profit-sharing system helps those who are willing to help themselves.

To the Company it means the gathering to their service of men interested in their own and the Company's welfare, with the inevitable result of amicable working.

In spite of the few who, by their thriftless conduct, do not take this "opportunity to improve their position in life by saving," the profit-sharing

system has proved a grand success, and has been accepted in the spirit in which it was proposed—the spirit of mutual good and goodwill.

In conclusion (and this letter but voices the general sentiment), we thank you, Sir, and the Directors of the Company for the kindly spirit animating you and them in dealing with the employees, and our sincerest wishes remain for the continuance of this system of profit-sharing, joined with the hope that its beneficial results may attract many adherents.

On behalf of the Committee,
(Signed) H. T. MANLY.

PARLIAMENTARY INTELLIGENCE.

GLEANINGS FROM THE COMMITTEE ROOMS.

THE various groups of committed Bills, which only a short time since looked almost overwhelming in their length, have nearly disappeared before the Coronation. During the past week or two, interest in the proceedings of the Committees has been on the wane. In fact, the doings of our Legislators altogether have lately dropped into absolute insignificance compared with the work of the carpenters, painters, and decorators in the precincts of the Houses and the Abbey. Nothing is thought of, nothing is talked of, and nothing is heard of as one approaches the business rooms of the Houses but the great event which is at hand; and it is not until the doors of the rooms close on one that attention can be concentrated on other matters. However, all these imposing preparations will, before another "JOURNAL" is published, have had their day and served their purpose, and will then be of the opposite extreme in value that they possess to-day. They will give place again to the old order of things; the special festivities and celebrations will gradually cease; and the general abandonment to pleasure will quickly be succeeded by a return to sober work. But so far as the Committtee-rooms are concerned, there is little more to be transacted in them this session. The early commencement of the session's Committee work, and the rapid rate at which private measures have been disposed of before the Coronation, prove the correctness of the surmise of four months or so since, that the position of affairs to-day is that which it was hoped to attain before the eventful week arrived. Success has attended the effort. The notes this week deal with the gas and water measures that have passed through the Committee stage during the past fortnight.

The Gas-Works Purchases of Bradford. The Committee procedure on the Bradford Corporation "Omnibus" Bill has been finally and satisfactorily disposed of. It will be remembered that the measure went through the House of Lords practically without amendment; and it has now had an easy passage before a Police and Sanitary Committee of the House of Commons. Here the Bill was unopposed. But there was a report from the Local Government Board to be dealt with; and the Committee wanted to hear evidence on the points assailed by the department. There are only two parts of the measure with which we are concerned; and these refer to the proposed purchase of additional gas-works and the betterment of the water distribution system in the outlying districts. Dealing first with the gas portion of the Bill, the Corporation have entered into an arrangement to purchase at a fixed price, three more undertakings—those of the Clayton, Allerton, and Thornton, the Airedale (Idle), and the Eccleshill and Bolton Gas Companies—all of which have their areas for the most part within the city limits. The differences in the prices charged for gas—in cases, as much as 1s. per 1000 cubic feet—and consequent discontent have, among other things, urged the Corporation into this large scheme of municipalization. It is not at all an unnatural thing for gas consumers when elevated to the position of citizens of a place like Bradford, to feel it is a little hard to have to pay more for a service such as gas than those fellow-citizens who are supplied by the governing body. While we may object to the principle of municipalization and to compulsory purchase, an agreed transfer under these circumstances is an altogether different matter. An attempt to purchase compulsorily was made by the Corporation in previous years; and it was very properly unsuccessful. The agreement now arrived at is on the basis of thirty years' purchase. The Bill, however, does not show the capital of the undertakings to be acquired; and therefore the Local Government Board advised the Committee to satisfy themselves that the price at which the bargains have been struck is reasonable. On this point, Mr. Charles Wood, the Corporation Gas Engineer, was examined; and from his evidence, it transpired that the cost of the purchase of the three undertakings will be £273,090. This he considers a fair sum. For the repayment of the required loan, the Corporation asked for a period of 40 years. But on this the Local Government Board had also something to say; and, after hearing the evidence, the Committee allowed 25 years.

Water Supply Outside Bradford. Beyond the city limits, the Bradford Corporation serve with water a population of no less than 169,000, who consume about one-sixth of the total supply. Two of the districts are served in detail; but speaking generally the supply is in bulk. It will be remembered that when the Bill was in the Lords, there was great opposition in connection with the water section; but, on the present occasion, all was plain sailing. The only thing required was to satisfy the Committee that the proposals were sound, and that the money powers were such as should be allowed. The Corporation are intending to improve the distributing system in the outlying districts by the construction of three service reservoirs at various points. These it is proposed to fill at night time, when the mills are not working and there is little private consumption. The estimate for the proposed works is put by Mr. James Watson, the Corporation Water Engineer, at £84,800; and this is considered reasonable and proper. The expenditure is projected entirely for the purpose of promoting efficiency; the benefit will go wholly to communities other than that of Bradford; but the liability, for any deficiency, if the revenue does not meet the charges, will fall upon the latter. The Corporation asked for sixty years for the repayment of the loan; and the Committee acquiesced.

The Result of Perseverance. Although it was announced in our editorial columns last week that the Barking and Ilford Gas Companies had been successful in their appeal to the Select Committee of the House of Lords, and had obtained the insertion of a clause in the West Ham Gas Company's Bill prohibiting the latter supplying in the statutory limits of the two smaller Companies without their consent in writing, the matter may, as it has been previously referred to in these notes, be mentioned as an instance of successful persevering determination. In the West Ham Gas Act of 1856, the limits of the Company were defined as including certain places, and "the suburbs and vicinities thereof and parts adjacent;" and the Barking and Ilford Companies, taking advantage of the West Ham Company's application to Parliament, sought protection against any encroachment on their districts under this old and indefinite clause. When the Bill was in the Commons, the Court of Referees decided that, as it had nothing to do with the question of limitations, the *locus standi* of the petitioners must be disallowed. The matter was also mentioned in the House two days later; but nothing came of it. The Companies not disheartened by this, laid their case before the Lords, with the success already alluded to. It is true the amendment is of purely local significance; but it is also significant as a lesson in perseverance. The powers sought by the Bill were fully described when it was before the Commons Committee; and no further change has been made by the Lords Committee, with the exception of the introduction of the protecting clause referred to. The arguments in connection with this matter are reported elsewhere.

The Rickmansworth Gas Bill. It is only necessary, in order to keep the record complete in this column, to chronicle the passing of the Rickmansworth Gas Bill through the House of Commons Committee. The proceedings were reported last week; and the features of the measure, and an idea of what transpired—resulting in modifications and a happy issue from disagreement—were set forth in brief form on p. 1628 of last week's issue. To that epitome it is sufficient to refer readers.

Binding the Kent Water Company. Necessity compels the Kent Water Company to apply for an enlargement of their spending powers simultaneously with the introduction of the London Water Bill of the Government. All they have asked for, however, is to be granted sufficient capital power to enable them to carry on their undertaking in such a way as to efficiently meet their obligations until their successors come into office. Their Bill has been before the Committee of which Lord Brougham and Vaux is the Chairman; and the new works have been proved to their Lordships' satisfaction to be an urgent requirement. The total authorized capital of the Company is £1,050,000; and this by the premiums has been raised to £1,150,644, the whole of which has been expended, with the exception of £3613. To meet their immediate necessities, the Company seek to raise further debenture stock to the amount of £150,000, of which £97,000 is wanted for mains and £36,000 for pumping-stations. The £150,000 is a reduction on the amount originally asked for; the modified figure having been adopted on the suggestion of the Local Government Board. The works are in actual progress, and constitute the extensions planned for this and next year. Lord Brougham and his colleagues were particularly anxious to assure themselves that the passing of the Bill would not enhance the value of the undertaking in view of its purchase under the Government Bill; and Mr. Alexander Dickson and the legal representatives of the promoters were able to convince their Lordships that it would not do so, and that only the actual capital expenditure would be brought into account, in accordance with an agreed clause inserted in the Bill when before the Lower House. There was a little feeble opposition on the part of a body calling themselves the Kent Water Preservation Association, who wanted to place some hampering restrictions upon the Company; but they spent their money fruitlessly. The preamble was declared proved; but so terribly concerned were the Committee that the Company should not deviate from concrete limits, that they ordered the insertion of a clause providing that particulars and estimates of the improvements, extensions, and expenses contemplated in the Company's undertaking should be furnished and inserted as an appendix to the Bill, in order to prevent and prohibit the application of any portion of the £150,000 to any purpose other than the completion of the works and wells already authorized by Parliament which cannot be postponed, and are necessary for proper distribution to the consumers. This tight-lacing of the Company is a matter over which they can be perfectly indifferent; for they will now be in a safe position to satisfactorily perform their duty to the end of their days, which is all that need concern them.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills read a second time and committed: Liverpool Corporation Bill, Local Government Provisional Order (Gas) Bill.

Bills reported: Bournemouth Gas and Water Bill, East Worcestershire Water Bill, Halifax Corporation Bill, Kent Water Bill, Knaresborough Improvement Bill, Leamington Corporation Bill, Newport Corporation Bill, West Ham Gas Bill.

Bills read the third time and passed: Bedford Corporation Water Bill, Belfast Corporation Bill, Birkenhead Corporation Bill, Bournemouth Gas and Water Bill, Broadstairs Gas Bill, South Metropolitan Gas Bill.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Lords Bills read the first time and referred to the Examiners: Nottingham Corporation Bill.

Lords Bills read a second time and committed: Margate Corporation Water Bill, Paisley Gas Provisional Order Bill.

Lords Bills read the third time and passed: Longwood Gas Bill, West Hampshire Water Bill.

The Joint Committee appointed to consider the London Water Bill

last week presented the following special report in regard to their procedure in connection with the third schedule of the Bill: "The Committee, on arriving in due course at the third schedule, went through it, and made various amendments thereto. On the question of passing the schedule as a whole, the Chairman was requested to put the question, 'That the schedule stand part of the Bill.' But he gave it as his decision that he should not so put the question, but that, if such a motion were made, he should put the question in the form, 'That the schedule be disagreed to.' The question having been put, and the numbers being equal, the Chairman (having in accordance with precedent no casting vote) ruled that the said schedule must stand part of the Bill, on the principle that no amendment should be made to the Bill as referred to the Committee by the House after second reading, unless there should be a majority in favour of such amendment."

HOUSE OF LORDS COMMITTEE.

Wednesday, June 11.

(*Before Lord* BROUGHAM *and* VAUX, *Chairman*, *Lord* MUNCASTER, *Lord* COLCHESTER, *the Earl of* ROMNEY, *and Lord* NORTH.)

WEST HAM GAS BILL.

This Bill has for its objects the consolidation and conversion of the share capital of the West Ham Gas Company, power to raise further capital, the construction of additional works on land belonging to the Company, and the reduction of the illuminating power of the gas supplied by them.

Mr. CLAUDE BAGGALLAY, K.C., and Mr. MOON appeared for the promoters; and Mr. PEMBER, K.C., and Mr. ERSKINE POLLOCK, K.C., represented the Barking Gas Company and the Ilford Gas Company, as petitioners against the Bill.

Mr. BAGGALLAY, in opening the case, said the opposition to the Bill was reduced to one petition—namely, that of the Barking Gas Company and the Ilford Gas Company; and as to this, he would have to take the opinion of the Committee in reference to the right of the petitioners to be heard.

The CHAIRMAN: When were the Company last before Parliament?

Mr. BAGGALLAY: In 1899. The principal fights in the other House were, with regard to the amount of the additional capital, the user of the land required for gas-works, the reduction of illuminating power, and the question of the alteration of the standard price. These matters were fought by the West Ham Corporation and the Leyton Urban District Council; and the other House adjusted the provisions relating to the matters to which he referred. At the present moment, there was no opposition on the part of these local bodies. The Company was originally incorporated by Deed of Settlement in 1846, and by statute in 1856. There had been two subsequent Acts—namely, in 1869 and 1889. The limits of supply of the Company were defined by section 12 of the Act of 1856. The population had grown to such an extent around the works that it was impossible to further extend them; and it was for this reason that the promoters were seeking power to use the land they now proposed for the purposes of manufacturing gas. The illuminating quality of the gas was originally fixed at 12-candle power. In 1869, it was increased to 14 candles; and in 1889 it was again raised by the Company to 16 candles. This increase was quite voluntary, and was made because the Company were in fact supplying 16-candle gas at the time. Originally the Company supplied gas at the maximum rate of 4s. 6d. per 1000 cubic feet; but at the present moment the supply was under a sliding-scale with an initial price. The total share capital authorized was £480,000; but no question was going to be raised as to that—the whole matter having been discussed and settled in the other House. The initial price at the present time was 3s.; but this was to be slightly lowered on a reduction being made in the candle power—the other House having allowed the power to be reduced to 14 candles. There was loan capital authorized to the extent of £160,000—making a total of share and loan capital of £640,000. Nearly all this capital had been raised and expended; but, of course, the whole of it did not bear dividend, as some portion was raised by the premiums that were earned by the sale of the more recently issued capital under the auction clauses. Since 1889, when the Company were last in Parliament, there had been a great increase in the population of the district. The gas consumption had also increased. In 1890—the year after the Company were last in Parliament—the sale of gas was 553 million cubic feet; and in 1901 the sale was no less than 1061 millions—this notwithstanding the competition of electric light in certain parts of the district. It was proposed to consolidate and convert the two classes of the ordinary stocks of the Company, which were partly 10 per cent. and partly 7 per cent., into a uniform 5 per cent. stock. Conversions of this kind had been found to be of great convenience. Conversion made it a better stock to deal with in the market. This provision was not opposed in the other House by either of the authorities, and it was not opposed here. As to the additional capital, the Company proposed originally to increase it by the amount of £600,000 of share capital and £200,000 of loan capital. At the instance of the West Ham Corporation, however, the House of Commons reduced the amount to £450,000 share capital and £150,000 loan capital—this being practically three-fourths of the amount asked for. The provisions as to capital, again, were not opposed in their Lordships' House. The amount of capital originally asked for was calculated to last about twelve years. With the reduction made, it would probably last about ten years. The third point of the Bill was the construction of additional gas-works. The Company had acquired 39½ acres of land on the eastern boundary of their district, on the banks of the River Roding. It was a very convenient site for new works, because of the level of the land and of the easy access both by rail and water. It was immediately contiguous to the London, Tilbury, and Southend Railway; so that there would be every convenience for getting coal. The last point of the Bill was as to the reduction of the illuminating power. It had been found in recent years that 14-candle power was a better power to utilize in connection with incandescent burners, and also for heating and cooking, than the higher illuminating power. At the present day, 14 candles practically represented the natural illuminating power which they could get from gas without using expensive enriching oils—cannel no longer being obtainable for the higher lighting power. This provision also was not opposed. None of the provisions of the Bill, in fact, were opposed. The only opposition was from the two Gas Companies who supplied adjoining districts. They did not raise any point as to what was in the Bill; but sought to deal with a matter which was not germane to it—a matter which was foreign to the Bill, and which, to his mind, did not concern them in any way. They petitioned to be heard against the measure in the other House, and the petition was fought out before the Court of Referees; and the *locus* of the petitioners was disallowed. He was now asking their Lordships to disallow the *locus* in this House. Counsel then dealt in detail with the petition of the opposing Companies. He pointed out that the material sections of it set forth that the limits of the Company's gas supply were described in section 12 of the Act of 1856, in the following terms:—

> The limits of this Act shall comprise the several parishes, wards, districts, hamlets, and places following—that is to say, West Ham, Stratford-Langthorne, Plaistow, Upton, Forest Gate, Hudson Town, East Ham, Wanstead, Holloway Down, Leyton, Leytonstone, Little Ilford, Walthamstow, Woodford, and Snaresbrook, *and the suburbs and vicinities thereof and parts adjacent*, all in the said county of Essex, except such part of the same county as is comprised within a segment of a circle of which the radius is a straight line one thousand yards in length measured from any point of the Essex extremity of the bridge known as the "Iron Bridge" over the River Lea in the Barking Road, Plaistow, in the said county of Essex.

The Committee would see that certain words in this clause of the petition were emphasized by being put in italic—namely, "and the suburbs and vicinities thereof and parts adjacent." It was upon these words that the issue raised by the petitioners would turn. In paragraph 9 of their petition, the petitioners pointed out that they were authorized to supply gas within certain well-defined limits, which extended along the eastern boundary of the district in which the Company now supplied gas for a distance of about seven miles. In paragraph 11, they said that it was not just or reasonable that, while they were strictly confined by Parliament to their own respective districts, and could not go beyond them to compete with other authorized gas undertakings, the promoters should be permitted to come into their districts and compete with them. They were most seriously apprehensive that such a state of affairs would be brought about if the Bill were to be permitted to proceed in its present state. Well, the promoters did not compete with these Companies, and had no intention of doing so; but they could not admit a restriction taking away their rights or obligations under existing Acts by the present Bill. The petitioners really wanted to repeal, *pro tanto*, or, to a certain extent, the provision of section 12 of the Act of 1856. The petitioners said their districts were "adjacent to" East Ham, Little Ilford, and other places named in section 12 of the Act of 1856. The petitioners said:

> And your petitioners cannot doubt that, so soon as it is in their interest to do so, the Company will claim that your petitioners' districts are covered by the words above cited, and, as such, are within their authorized limits of supply. Hitherto the Company have not attempted to invade your petitioners' district, nor are they, in fact, in a position to do so without obtaining from Parliament fresh statutory powers for the purpose, such as they are seeking under the present Bill; for the capital powers of the Company are nearly exhausted, and their existing site for the manufacture of gas is not only, your petitioners believe, fully occupied by the supply of gas to the area of the Company's existing supply, but is situate at a considerable distance from the boundary of your petitioners' district.

If the Company wanted to go there, it would not be the question of distance that would be material. It would be whether they were obliged to go, or desired to go. But he might tell their Lordships that there was nothing in the notices which had been given of the Bill in December which would enable them to insert in the Bill anything which would take away the existing rights, whatever they might be, of persons within their district. Having existing rights, it would be a breach of the Standing Orders of Parliament to take them away without previously having given notice of such provision. Then the petitioners said: "Accordingly, by the present Bill, the Company seek to enlarge their powers, so as to place themselves in a position to compete with your petitioners in your petitioners' statutory areas of supply. By the incorporation of the Gas-Works Clauses Act, 1847, they would obtain powers to break up streets and roads, and to interfere with mains and pipes, including the mains and pipes of your petitioners, laid in their own districts under express statutory powers." He absolutely denied that the promoters wished to compete with the petitioners; and it was not the fact that, under the Gas-Works Clauses Act, incorporated with the Bill, they would be able to interfere with the mains and pipes of the petitioners. If they had power at all, it was under existing legislation. The petitioners further said:

> By section 7 of the Bill, they seek power to erect and maintain new gas-works on the frontier of the statutory district of your petitioners, the Ilford Gas Company, and actually within the statutory district of your other petitioners, the Barking Gas Company, and to take and hold for the purpose a piece of land having an area of no less than 39 acres, which is more than double the area of their existing site. By sections 18 and 25 of the Bill, they further seek power to raise additional monies amounting to no less than £600,000, which is more than their entire capital as authorized at the present time. Your petitioners cannot believe that new powers on such an extensive scale are sought by the Company merely for the supply of the district which they at present serve.

He could assure their Lordships that the money sought was for the purposes of the present area of supply; and so it was proved in the other House. It was after hearing the Leyton and West Ham Authorities that the present figures as to capital were fixed; and he could assure his learned friend that the Bill had not been framed, either as to the site of the works or amount of capital, for the purpose of invading the districts of the petitioners. That was not their intention. In paragraph 12, the petitioners said:

> Your petitioners do not believe that Parliament intended, by the vague and indefinite words above cited from section 12 of the Act of 1856, to authorize the Company to compete in the statutory districts of your petitioners. But they are advised that to obtain a judicial interpretation of the said words would involve long, difficult, and costly litigation, the cost of

which would ultimately have to be borne by the gas consumers. It is, moreover, not easy to understand how a judicial tribunal, whose function is to interpret existing law, could decide of its own motion how far the limits of the Company's gas area shall be permitted to extend in future. Your petitioners respectfully submit that such a decision is legislative rather than judicial, and appeal to Parliament to say that no vague general words enacted nearly fifty years ago, and never acted on up to the present time, shall avail to authorize the Company to compete in the districts which Parliament has in definite and precise terms assigned to your petitioners.

There the petitioners were distinctly asking their Lordships to alter the provision of section 12 of the Act of 1856. It was a very curious thing that in 1867 the Barking Gas Company had a Bill in Parliament in which they endeavoured to invade a portion of the West Ham district at Little Ilford. West Ham pointed out that section 12 of the Act of 1856 reserved that district to them. So that the petitioners knew, so long ago as 1857, what the position was; and yet they did not attempt to limit the area within which the West Ham Company could supply. The Barking Company had a Bill in Parliament this session; and in that they could insert a limiting provision. If they wanted to alter the boundaries, they should do so in a Bill of their own. There would then have been no risk of a breach of the Standing Orders. The petitioners said:

Even if it were clear that Parliament in 1856, when the whole neighbourhood was practically agricultural land, had intentionally placed your petitioners' districts, or any parts of them, within the area of supply of the Company, your petitioners would urge that now that West Ham, Ilford, and Barking contain densely populated districts, such legislation, which has not been acted on for more than forty years, should be repealed, as having been proved to be inimical to the public interest, and as being contrary to the present parliamentary practice. In the early days of gas legislation, it was not uncommon for two companies to have statutory powers within the same area. But as long ago as 1860, in the case of the Metropolitan Gas Act, Parliament abandoned this principle, which had been found not to secure for the public the benefit of competition, while it subjected them to the inconvenience of having their roads and streets broken up more frequently than would otherwise be necessary. Parliament now relies for the regulation of the gas industry on publication of accounts and statutory limitation of dividends, and confines each company to a strictly defined area with a strictly limited site for manufacture.

This would have been a good point for a local authority to have made if the proposal were to adjust the boundaries; but it did not touch his point as to Standing Orders. The petition went on to say:

As recently as 1899, your petitioners, the Ilford Gas Company, when applying to Parliament for further powers, were compelled to more clearly define their area of supply; and in the present Bill, the Company, in conformity with the requirements of Parliament, are defining accurately the site on which they are now authorized to manufacture gas, which was insufficiently defined by the Act of 1856. Your petitioners submit that it is equitable, and in accordance with precedent, that the Company should also be required in their Bill to define accurately their area of supply, and that such area should be so defined as to exclude the areas which have been assigned by Parliament to your petitioners, and within which the Company have never attempted hitherto to serve the public. The Company, by their Bill, are seeking to amend their existing Acts for their own benefit and advantage, and to remove the limitations and restrictions which afford protection to your petitioners.

Well, there were no limitations and restrictions which afforded protection to the petitioners, except that the promoters were coming to the end of their capital. There was no other protection that they were interfering with at all. The petitioners finally said: "Your petitioners submit that it is incumbent upon the Company at the same time clearly to define the limits of their supply and of their intended operations, in conformity with the present parliamentary rules; and your petitioners respectfully ask that the powers now sought by the Company should not be granted, except on condition that they shall be used for the supply only of the parishes and places now supplied by them, and that a clause be inserted in the Bill for clearly defining the Company's limits of supply, and confining their powers of supply to the district which they at present supply." He submitted, again, that this petition raised a question which was not germane to the proposal of the Bill. The promoters were not going to alter the existing limits of supply. They were only endeavouring to restore the same position as to capital to go on with as was given to them in 1856, in 1869, and in 1889. On each of these occasions they had obtained capital just as they were proposing to obtain it now. They had not the slightest *arrière pensée* as to the matter; but what they did object to was having in a Bill for a certain purpose a clause inserted which was not germane to that purpose, and to accede to which would jeopardize the Bill on Standing Orders. Power to supply certain inhabitants could not be given up without due notice to those inhabitants. He asked their Lordships to sustain the decision of the Referees in the House of Commons.

Mr. PEMBER then addressed the Committee for the petitioners, and said that his position was at all events capable of being very easily defined. He did not ask their Lordships to embark on a long investigation into the domestic affairs of the Company. They need not be afraid he was going to ask them to do anything as to the illuminating power of the gas, the price of the gas, or the limitation of capital. These were matters which would have interested the Local Authorities; but they were no affairs of his. He objected, under the circumstances proposed by the Bill, to the maintenance of obsolete words which found a place in clause 12 of the Act of 1856; and provided that he were guaranteed that there would be no supply by the West Ham Company in the districts of the Ilford and Barking Companies—which guarantee could be given in a very simple clause or proviso—he should be satisfied. In dealing with matters of *locus standi* before their Lordships, it was only necessary to show that there was a substantial case to be made out for an alteration of the Bill. This prevented the overriding of the merits of the case by a mere technicality. The Act of 1856, which gave the promoters the power to which he objected, became law before the passing of the great London measures by which the system of competition was done away with, and that of districting was adopted. His learned friend admitted that his Company did not propose to compete with the petitioners in either of their districts. Then why should not the Bill say so? It was not a question of there having been competition up to this time, and fresh capital being required to increase that competition. There had been no competition. He submitted that alterations of the nature of that which he proposed had been made in old Acts from time to time, and no question as to Standing Orders had arisen.

The CHAIRMAN: The *crux* of your petition is fear of invasion?

Mr. PEMBER: Yes.

The CHAIRMAN: The promoters say they will not invade your district. If they will put in a clause making that clear, would not that satisfy you?

Mr. PEMBER: Yes.

Mr. BAGGALLAY said he was afraid of the technical point as to the breach of Standing Orders. He would give an undertaking that, unless they were compelled by consumers in Ilford or Barking, they would not invade the districts of the other Companies. He would go further, and say that if the petitioners chose to promote a Bill, having given the proper notices, to rectify the boundaries, he would not oppose it.

Mr. PEMBER said that if his learned friend's suggestion were adopted there would be nothing to prevent someone on the Board of the West Ham Gas Company putting up a person in the Ilford or Barking district to demand a supply of gas from the West Ham Company, in which event the undertaking would become waste paper. As to the petitioners promoting a Bill to overcome a technical danger, such a step would be expensive and absurd, when an easy and inexpensive process was offered by the present Bill. If the Standing Orders Committee regarded the protective clause proposed as fatal to the Bill, he would undertake at once to withdraw it. Counsel pointed out that clauses of this kind had been inserted in Acts relating to Todmorden, Brynmaur, Milton, and Chesterfield. These Companies were all the creatures of Parliament, and depended upon the fiat of Parliament as to what their powers should be. If Parliament gave its fiat, everyone must accept it; and Parliament was not to be restrained by old and obsolete, and he ventured to say unconstitutional, words in an Act.

The CHAIRMAN: I understand that the adoption of the Chesterfield clause would satisfy you.

Mr. PEMBER replied in the affirmative.

Mr. BAGGALLAY said he still maintained his position as to there being no *locus standi;* but, however their Lordships decided that, he was quite willing to give an undertaking not to go into the petitioners' districts for purposes of supply unless compelled, and not to oppose any Bill the petitioners might choose to promote. It was absurd to suppose that anyone connected with the West Ham Company would put up a person to demand a supply of gas in the Ilford or Barking districts. Such a demand would involve the laying down of mains which would prove useless when the Bill was passed for alteration of boundaries. As to precedents in other cases, this question had arisen in connection with the incorporation of a Company for the first time.

The COMMITTEE, having deliberated in private, decided upon giving the petitioners *locus standi*.

Mr. *Corbet Woodall* then gave formal proof of the preamble of the Bill. He pointed to the necessity of further works on the site proposed, and could state most positively that there was not the slightest idea of going into the Barking or Ilford districts for purposes of supply. He could say, as Consulting Engineer to the Company, that the estimates did not contemplate any alteration of the Company's area of supply.

In cross-examination by Mr. POLLOCK, witness said he was of opinion that competition between gas companies was not advantageous. It was to the advantage of the public to have companies doing their duties thoroughly in well-defined districts.

Mr. BAGGALLAY said that concluded the case for the Bill. The question now was whether a new clause should be inserted in it.

Mr. POLLOCK said he would propose a clause that: "Nothing in section 12 of the Act of 1856 or this Act shall be deemed to authorize the Company to supply gas within the limits of the Ilford Gas Order of 1873, or the Barking Gas Act of 1867."

Mr BAGGALLAY said this would imperil the Bill on Standing Orders, and, besides, it was not fair to put in such a provision behind the backs of the Local Authorities and consumers without notice.

Mr. POLLOCK said that Earl Morley, who would consider the question of Standing Orders, would be made aware of the fact that the promoters opposed the clause. He (Counsel) would not call evidence.

The CHAIRMAN: We are of opinion that the Chesterfield clause should be followed in this case.

The following clause was then agreed to: "Nothing in section 12 of the Acts of 1856, 1869, 1889, or in this Act, shall be deemed to authorize the Company to supply gas within the limits of supply of gas as defined by the Barking Gas Act of 1867 or the Ilford Gas Order of 1873, except with the previous consent, in writing, of the Barking Gas Company or the Ilford Gas Company, as the case may be."

Mr. BAGGALLAY: Of course, I cannot formally consent to that; but I think it carries out the view of the Committee.

The remaining clauses of the Bill were then adjusted; and the preamble was declared proved.

Reductions in Price.—The Cardiff Gas Company announce that, as from the reading of the meters for the June quarter, the price of gas in Cardiff and Penarth will be reduced to 3s. per 1000 cubic feet, and in the outside districts to 3s. 6d. It has been decided that the reduction of 3d. per 1000 cubic feet in the price of gas at Bradford, which follows from the new arrangement in regard to the cost of street lighting, shall come into force on July 1. From that date consumers will be charged at the rate of 2s. 3d. per 1000 cubic feet.

More Interference with Gas-Mains at Ilford.—Last Tuesday, Major-General Hutchinson, R.E., conducted an inquiry, in the nature of an arbitration, at Ilford, on behalf of the Board of Trade, into a complaint made by the Ilford Gas Company against the Urban District Council of interference with their mains by the construction of a tramway. In the execution of this work, the laying of the concrete bed and the formation of earthenware chambers for the cables had prevented the Company from connecting service-pipes to the mains or getting at others already laid. Their Engineer (Mr. J. H. Brown), Mr. E. H. Stevenson, and Mr. J. Swinburne supported their contentions, which were denied by the Council, for whom Mr. W. A. Valon gave evidence. The Arbitrator reserved his decision.

JOINT PARLIAMENTARY COMMITTEE ON THE LONDON WATER BILL.

(*Lord* BALFOUR OF BURLEIGH, *Chairman.*)

Twentieth Day—Tuesday, June 10.

On the reassembling of the Committee this morning,

Mr. FITZGERALD, for the promoters, said it would not be possible for the Committee to settle clause 1 until the Third Schedule ("Representation of Authorities on the Water Board") had been dealt with; and he therefore asked the Committee to proceed with that.

The CHAIRMAN assented.

Mr. BALFOUR BROWNE said the London County Council proposed to call evidence in support of their amendments, and he would address the Committee afterwards.

By amendment A, the Council proposed to substitute 29 members for the 69 proposed by the Bill, and to give the Council 16 of those members. By amendment B, they proposed, in the alternative, that the Board should consist of 33 members, of whom the Council should have 14. This amendment, on which the Committee subsequently voted in a certain way, was as follows: London County Council, 14; Common Council of the City of London, 2; County Council of Essex, 2; Council of the borough of West Ham, 2; County Council of Kent, 3; do. of Middlesex, 4; do. of Surrey, 3; do. of Hertfordshire, 1: Conservators of the River Thames, 1; and Lee Conservancy Board, 10.

The CHAIRMAN, after a brief consultation with the Committee, said he supposed old ground would not be reopened.

Mr. FREEMAN said evidence would be directed to the desirability and advisability of a smaller body being constituted than that proposed by the Bill. Evidence of actual cases where a smaller body had been able to deal with similar work would be given.

Sir *Basdin Leech*, Deputy-Chairman of the Water Committee of the Manchester Corporation, was then called, and examined by Mr. FREEMAN. He said his Committee had the administration of the water supply of Manchester and of 24 adjacent districts. It now consisted of 18 members, though formerly there were 25; but the work was done equally well with the smaller number. From his experience, he thought 69 members would make the London Water Board far too large. The whole of the business of his Committee was conducted by three Sub-Committees; and he did not think the claim that there would be a large number of Committees on the proposed Water Board was a sound one. He thought the members from the smaller districts would not be so competent to manage the business as representatives from the London County Council, who would be the elected of the elected. In Manchester they had attempted to have representatives of the various wards on the Committee; but the system had broken down. The complaints which from time to time arose were mainly dealt with by the officials.

In cross-examination by Mr. FITZGERALD, witness said he considered that the London County Council should have the management of the water supply; and the fact that the five other counties interested were determined not to come under their control did not weigh with him.

Mr. *W. J. Burgess*, Chairman of the Water Committee of the Liverpool Corporation, said there were 20 members on that body, and they found no difficulty in performing their duties. He saw no objection to the London County Council being paramount on the proposed Water Board.

In cross-examination by Mr. BLENNERHASSETT, witness said he thought the fact that the Metropolitan Boroughs had nothing to do with sewage was against them with regard to representation.

Mr. *W. Anderson*, Treasurer of the Edinburgh and District Water Trust, said a private Company's undertaking was transferred to the Trust by Act of Parliament in 1869. The undertaking was now administered by a body of 25 Trustees—18 for Edinburgh and the others for Leith and Portobello. The work was done very effectively by three Committees—Works, Finance, and Law. The population supplied was 429,000.

Mr. FITZGERALD (in cross-examination): If 25 Trustees are required to manage one water undertaking supplying 429,000 persons, how many do you think would be needed to manage eight undertakings supplying 6 million people?

Witness: I do not think it necessary to work out that sum.

Mr. *J. Bowers*, one of the Deputy Town Clerks of Glasgow, having charge of the secretarial and legal work of the Water, Gas, Electricity, and City Improvements Departments of the Corporation, said the water undertaking was acquired by the Corporation in 1855, and had since been administrated by a Water Committee of 28 members. The area supplied extended to 87 square miles, out of which the City of Glasgow occupied only 12½ miles. The total population within the limits of supply was 1,058,000. None of the boroughs or local bodies outside Glasgow had any representation. He thought the 69 members proposed by the Bill would make the Water Board too unwieldy and unworkable, and would militate against efficient administration.

Mr. *G. F. Deacon*, formerly Water Engineer to the Liverpool Corporation, examined by Mr. THESIGER, said the total population supplied in that city was 1,022,000, of whom 870,850 were supplied compulsorily, and 151,150 in bulk. Of the total, 743,505 were represented. He did not think the Committee work involved in connection with the management of a water undertaking was necessarily proportional to its magnitude—in fact, it certainly was not so. One often found that the smaller the town the larger the Committee. Evidence went to show that generally in the towns dealt with by the witnesses the Committees ranged from 18 to 28 in number—28 being the maximum. He thought this number was too large.

Mr. THESIGER: In a large undertaking, the subdivision of superintendence is necessary; but this, of course, would entail a greater number of executive officers?

Witness: Yes. It is a matter of organization; but it would not necessarily increase the work of the Committees.

Do you consider there would have to be Committees to hear complaints all over London?—I think it would be quite impracticable.

In further examination, witness said, in regard to the magnitude of the undertaking, that London had no distant water-works to compare with Liverpool, Manchester, Birmingham, Edinburgh, and Glasgow. All the principal sources were close at hand. Even the area of supply could not compare with some modern cases. For instance, the Derwent Valley Water Board had an area five times as large as the whole of London. Taking it generally, he undoubtedly preferred a body such as was suggested by the London County Council to that proposed by the Bill.

Cross-examined by Mr. FITZGERALD: The Derwent Valley Board had nothing to do with the distribution of water, in the sense of detailed distribution. They supply water to the limits of districts five times as large as the whole area of the distribution of London; but they did not distribute in detail in those districts.

In cross-examination by Mr. BLENNERHASSETT, on behalf of the Metropolitan Boroughs, witness agreed that it would be desirable to have on the Water Board men of the very highest business capacity, who would naturally have other affairs to attend to, and therefore could only give a moderate portion of their time to the affairs of the Board.

Mr. *W. B. Bryan*, Chief Engineer of the East London Water Company, was then called on behalf of the promoters. In reply to Mr. RICKARDS, he expressed the opinion that the number of members proposed by the Bill was not too large to manage the undertakings of the eight Water Companies, having regard to the different interests of the area to be supplied. He agreed that the amount of detailed work would be very large, and would have to be delegated to the Committees and Sub-Committees.

Mr. RICKARDS: Would it be advisable to divide Water London into several districts?

Witness: It would be absolutely necessary to decentralize to a considerable extent, and divide London into a number of districts, for their proper management. Roughly, I think the better plan would be to divide the area north of the Thames into three districts, and that south of the Thames also into three. Each of the six districts would be quite as large as the supplies of Manchester, Liverpool, or Glasgow. I would suggest having a Committee for each district, and, in addition, there must be a number of Sub-Committees.

In further examination, witness said his Company's area comprised a population of about 1,450,000, and under the Bill, twelve members were allocated to the district served. He did not think this number in any way excessive for that large district. There was no parallel between the management of a great undertaking by a comparatively small body of paid directors, where few changes occurred, and by a public Board consisting of representative members of the different districts supplied. There must be a larger Board in the latter case. The Board of 1869 was certainly not excessive. In the years 1865, 1866, and 1868, his Company had had great help from members of the different Councils within their district of supply, and from their officials. Members of the Borough Councils also rendered the Company considerable assistance during the droughts of 1896 and 1898. In his opinion, taking into account their local and personal knowledge, that assistance could not have been given equally well by members of the London County Council.

In cross examination by Mr. BALFOUR BROWNE, witness said there were nine Directors in his Company, for the supply of 1,450,000 people; whereas the Chelsea Company had a like number for only 290,000.

Mr. FITZGERALD said he had a number of representatives from various Metropolitan Boroughs who were anxious to state to the Committee the desire of their boroughs to be represented on the Board; but the evidence was of the same class as that which the Committee had already heard, and therefore he was desirous of not unduly taking up time.

The CHAIRMAN said their names could be given, and if the County Council desired to cross-examine any of them, they could intimate this wish, and the witness could be called.

Mr. FITZGERALD said they were the Mayors of Holborn, Kensington, and Hammersmith, and the Chairman of the Special Water Committee of the Hackney Borough Council.

Counsel on behalf of the City of Westminster, East Ham, the County Council of Middlesex, the Urban District of Hornsey, the Hertfordshire and Essex County Councils, and the Wimbledon Urban District Council, expressed their assent to the proposals of the Bill with regard to their representation on the Water Board.

Mr. BALFOUR BROWNE urged the Committee to adopt the amendment before them, to constitute the Board on the lines proposed in Lord James of Hereford's Bill, as the London County Council was not allowed to be the Water Authority itself. He reminded the Committee that Lord James's Bill recommended a body upon a county basis, with a large representation of the London County Council, though far below what it would have either upon the basis of population or of rateable value. The decision of the Chairman that the Committee revoked the resolution of the 30th of April on an equality of votes had come as a great disappointment to the Council; and it appeared to him that his Lordship would have to consider the rule of the Upper House in reference to this matter. He understood that Committees of the House were guided by the same principle.

The CHAIRMAN: It does not apply to Joint Committees?

Mr. BALFOUR BROWNE: This is a new practice. I do not know what it is.

The CHAIRMAN: I have had the precedents carefully looked up, and they are formed by the Duke of Richmond's Joint Committee on Railway Rates and by the Electric Powers Committee under Lord Cross. [His Lordship then quoted extracts from the reports to prove the accuracy of his ruling.]

Mr. BALFOUR BROWNE urged that the question would have to be put "Shall Schedule III. stand part of the Bill?"

The CHAIRMAN: The question according to these precedents is that certain lines should be left out for the purpose of inserting others; and on an equality of votes this will be decided in the negative.

Mr. BALFOUR BROWNE said this, in effect, gave to the Chairman of a Joint Committee a casting vote, by the method of putting the question, which he would not have as Chairman of a Committee of the Lords. He should have thought the rules of the House of Lords would have governed a Committee of both Houses.

The CHAIRMAN said he must act according to the precedents, which he was advised were these. No doubt the matter would be subsequently

debated. The question would be so put that an equality of votes would leave the Bill as it stood.

Mr. BALFOUR BROWNE said that if the question put were that the schedule should stand part of the Bill, it would go out.

The CHAIRMAN: And, of course, by the same number of votes nothing could be inserted in its place.

Mr. BALFOUR BROWNE: Then you would come to a deadlock. The whole object of the rule of your Lordships' House is that on a mere equality of votes there shall be no legislation.

The CHAIRMAN said he could not carry the discussion further. He had given the precedents.

Mr. BALFOUR BROWNE then continued his argument in favour of the amendment being passed. He said by the Bill the Committee were asked to change the whole constitution of the government of London, and to give the Metropolitan Boroughs powers which it was never intended they should have. The London County Council believed the Middlesex County Council were not in favour of the scheme. If there had been a resolution of that body in support of the proposed constitution, it could have been put in. The other bodies—Essex and Kent—wished to go out; and Surrey desired the Board to be so constituted that it might have representation on the county basis. If these bodies were let out, what became of the constitution of the Board? No one was left but the Administrative County of London and its boroughs. Who was in favour of the constitution? Nobody. Hertfordshire was merely afraid to be left alone with London, its bigger neighbour. In conclusion, the learned Counsel asked the Committee to redeem their inconsistency by being inconsistent once more. He appealed to them to go back, before it was too late—before the future history of this "mongrel Water Board" condemned them, as it inevitably would if they constituted it in the manner they had done up to the present. The only way out of the present impossible situation was to go back to the resolution of the 30th of April, and constitute the Board as proposed by Lord James of Hereford, if they would not, as he understood was the case, recommend that the County Council should be in exactly the same position as every other great authority in this country—the purveyors of water for London.

Mr. WEDDERBURN said the Kent authorities preferred the Bill as it originally stood, so long as they remained an integral portion of the undertaking.

Mr. FITZGERALD, in reply, said the amendment would give the London County Council a preponderating voice on the new Board. As they could not be the purchasing body, they wanted a majority on the Board to which all the other counties were hostile. Lord Llandaff's Commission had reported expressly against their having a preponderating voice, and proposed to give them 10 members out of 30. It was impossible, for political considerations—not using the word in its party sense at all—to force four or five counties into the Water Board where the London County Council had a preponderating voice, if all those counties were bitterly opposed, as they were, to be put under their dominion. To sum up, the great majority of the Metropolitan Boroughs were in favour of the Bill, while the City of London opposed it, as did the urban districts outside London, almost without exception, and practically all the County Councils.

Lord CREWE asked Counsel if the Local Government Board took the view expressed by Mr. Bryan, that it would be necessary to divide the area into six districts.

Mr. FITZGERALD said he did not think the matter had been gone into exhaustively by the Board. Ultimately the question must be decided by the Water Board themselves. During the time which must elapse before the amalgamation could take place, it would be desirable to have something in the shape of an existing Committee watching over each individual undertaking. He should attach great value to Mr. Bryan's view, and should think it correct; but he could not say the Local Government Board had considered the point.

The Committee-room was then cleared. On the re-admission of the public,

The CHAIRMAN said: Amendment A was rejected by the Committee unanimously. Amendment B was rejected on an equality of votes. Subsequently to that, another amendment was moved by a member of the Committee to alter the representation of the London County Council from 10 to 16, and to take one of the extra 6 from each of the Metropolitan Boroughs which the Bill proposes should have two. This amendment was lost by 7 votes to 3. The Committee consider that they have heard the next amendment—to increase the representation of Westminster—and do not propose to accept it. They are unanimous on this point.

Mr. FITZGERALD said he agreed to the amendments on behalf of Tottenham and Hornsey, including them among the bodies in the schedule of representation on the Board. The latter, with Wood Green, would have one member; and Edmonton, Enfield, and Southgate one.

These changes were accordingly agreed to.

Mr. RIGG moved to add the County Council of Wiltshire to the schedule.

Mr. *C. Hobhouse*, M.P., and member of the Council, was called in support of the amendment; but it was rejected.

Mr. RIGG then moved an amendment to give the County Council of Berkshire a representative.

Mr. *Russell*, an Alderman of the Council, gave evidence in favour of the amendment.

The CHAIRMAN said it had been suggested by a member of the Committee, in conversation, as to whether, if an addition were made to the representation of the Conservators of the River Thames, coupled with the provision that the new member should represent the up-river district, this would meet the views of Berkshire.

Witness said it would, to some extent, but he did not think it was the best alternative.

The further consideration of this amendment was adjourned.

Twenty-First Day—Wednesday, June 11.

At the commencement of the proceedings to-day,

Sir *F. Dixon-Hartland*, M.P., Chairman of the Thames Conservancy, was called in reference to the suggestion made by the Committee at the close of the previous day.

Mr. BAGGALLAY: The suggestion of the Committee shortly is that it should be considered whether, if an extra representative were given to the Thames Conservancy, he should be selected from the members on the Board for the upper reaches of the river. Will you explain your view to the Committee?

Witness: We are strongly of opinion that this would take away the whole value of giving us an additional representative. The object of having another is that we may always have one to give our views upon all questions to the Water Board. If there is one for the upper and one for the lower reaches, it would divide their power of speaking. There is no antagonism between the upper and lower river. I have been Chairman for many years, and I should say there has been no solitary instance in which the wishes of the Upper River Board have not been carried out without interference by the Lower River Board and there is no reason why this should not continue.

Mr. BALFOUR BROWNE, speaking on behalf of Berkshire, said he was quite willing to accept the suggestion thrown out by the Committee; and he asked them to adhere to that. It was quite obvious that on such a large Board the upper river people were represented in a very small way. The Thames Conservancy were paid a large sum to keep the river pure for the Water Companies for the benefit of London, and they kept a sharp eye upon those counties where the sources of water were—Berks. and Wilts. being two of them. This was quite right; but it was also right that Berks. and Wilts. should have some say in the matter. He therefore asked that there should be two members on the Water Board representing the Thames Conservancy, and that one of them should represent the upper river.

Mr. FITZGERALD said the amendment of the Thames Conservancy asked for four representatives, to which the Local Government Board could not agree. They saw no objection to the representation being increased to two. As to whether one should be allocated to the upper Thames, that was a question with which they did not desire to interfere.

The Committee-room was then cleared. On the re-admission of the public,

The CHAIRMAN said: The Committee are unanimously against adding another representative to the Lea Conservancy. As far as the other points are concerned, the Committee have resolved to add two members to the Thames Conservancy, making three members in all, one of whom is to be the representative of the upper districts. Otherwise the schedule will stand, as amended, as part of the Bill. I am requested by the Committee to say that the process by which we have arrived at this decision will be made the subject of a special report.

Schedule III., as amended, was then passed, and the consideration of Schedule IV. proceeded with.

Mr. BAGGALLAY, on behalf of the Middlesex County Council, moved the deletion of the first paragraph: "A person shall be disqualified for being appointed a member of the Water Board by any constituent authority unless he is a member of the body of one of the bodies forming that constituent authority." He said the Middlesex County Council thought that a body should not be tied down to choose a representative from among their own members. In that way greater efficiency and more continuity would be secured, as a man would not cease to be a member of the Water Board because he happened to lose his seat on the County Council. Some of the present Directors of the Water Companies were living in Middlesex, and were not members of the Middlesex County Council. That body might prefer to choose their members from those gentlemen.

Mr. FITZGERALD said the Local Government Board did not object to the amendment, if the Committee thought it advisable. It would simply remove a disqualification, and leave the matter entirely in the hands of each constituent authority.

The CHAIRMAN (after briefly consulting his colleagues): The amendment is accepted.

Mr. BAGGALLAY next moved an amendment the effect of which was to make paragraph 5 read: "A member appointed by a constituent authority consisting of the Councils of more than one urban district shall be appointed by the Chairmen of those Councils." He said this would get rid of the cumbersome machinery necessary for appointing Joint Committees.

The amendment was, however, rejected.

Several amendments consequential upon decisions of the Committee were inserted in the schedule, which was then passed as amended.

On clause 1,

Mr. FITZGERALD said the number of members (67) would have to be deleted, and 71 substituted. All the other amendments had gone.

Clause 1, as amended, was agreed to.

Clause 2, dealing with the transfer of the undertakings, was struck out, and a new clause inserted, carrying out the decisions of the Committee.

On clause 11, sub-section 2,

Mr. THESIGER brought up two amendments by the London County Council, by which the clause would read as follows (the new words being in italics): "Any sum required to meet any deficiency in the water fund . . . . shall be apportioned amongst the City of London and the parishes in the County of London and in the boroughs and urban *and rural districts outside London within the limits of supply* in proportion to the rateable value appearing in the valuation lists in force on the preceding sixth day of April." The words proposed to be deleted, for which the italicized words were substituted, were, "and urban districts outside London, the Councils of which are for the time being entitled to be represented on the Water Board," "in proportion," &c. The remainder of the sub-section after "sixth day of April," which, by the second amendment, was proposed to be deleted, read, "of the hereditaments at that date supplied with water by the Water Board or any Metropolitan Water Company in the City and each such parish." He said the Committee had, on a previous occasion, asked for a table showing what the effect of the amendment would be, and he would call a witness to do that. He did not propose to argue the question again.

Mr. *E. J. Harper* was then recalled, and produced the table referred to.

Mr. FITZGERALD (in cross-examination): The evidence you gave to the Committee before was to this effect—that, though you had taken in your table (showing the effect of the Local Government Board's proposal) only the annual value of the hereditaments chargeable to water-rate in the year 1898, this was substantially true without adding to it the hereditaments supplied by meter?

Witness; I do not think I went so far as that. My impression is that the addition of the properties supplied by meter would not make so great an alteration as to destroy the general result of the table.

Have you taken any steps to verify that statement?—I have not sufficient data. I was only pronouncing a general opinion.

Witness was then cross-examined with the object of proving that the conclusions to which the table would lead were erroneous, and that the inequalities of rating which it showed in the exceptional circumstances set out, practically disappeared if the full rateable value of the premises actually supplied with water were taken. He said he could not accept this view, because the railways and other properties which did not take water at all, either by meter or by payment of rates, would remain, and they would disturb the calculation and produce a certain amount of inequality, although not to the extent shown in the table.

Mr. FITZGERALD: Bermondsey is one of the places in which inquiry has been made, and it turns out that instead of a figure of £258,000 rateable value, if you took the rateable value at the present moment of all the premises supplied it would be £396,785, and you see at once the inequality which you point out would disappear?—*Pro tanto.*

Altogether?—The total assessable value is £427,839, and there would still remain a difference.

In cross-examination by Mr. LANKESTER, for the South Essex Water Company, witness admitted that within the parishes of Ilford, Barking, and Dagenham the South Essex Water Company had a very large rateable value, and that under his scheme they would also be rated with the rest of the parish towards a deficiency rate of a competing water supply.

Mr. LANKESTER: Do you think that fair?

Witness: I think if you were to attempt to do exact even justice to every hereditament in regard to rating, you would have such a state of chaos that the rates would not be raised.

It is obviously unfair to rate them?—They are ratepayers in the parishes, and I see great difficulty in exempting them. It would be a trifling charge, which may, in fact, never arise.

We have £1365 within those parishes?—That may be; but you would not have to pay anything like that towards the Water Board's deficiency.

Mr. WEDDERBURN, for the Kent authorities, asked the Committee to reject the amendments on three grounds: First, that it would prejudice matters hereafter; secondly, the difficulty of dealing with parishes partly within and partly without; and, thirdly, that it was a matter outside the purview of the Bill.

Mr. GRUBBE adopted Mr. Wedderburn's arguments on behalf of Essex.

Mr. LANKESTER, for Hertfordshire, and Mr. HUTCHINSON, for the Urban District Council of Ilford, opposed the amendment.

Mr. FITZGERALD, dealing first with the urban districts, said the amendments would be doing great injustice, because there were large districts on the edge of Water London which either got no supply at all from the London Water Companies or only, as in the case of Barking, an infinitesimal supply. These districts, generally speaking, were supplied by other Companies, and really had no interest whatever in the question of the London Water Supply. As instances of this, Dagenham and Romford were supplied entirely by the South Essex Water Company, and Barking also, with the exception of one house. The only answer to such cases was that because there was a possibility of their being supplied by the Water Board, therefore they ought to contribute to the deficiency rate. He submitted that this would be very unfair indeed. With regard to the rural districts which were partly supplied, they were not represented on the Water Board at all; and it was thought unreasonable, therefore, that they should be made subject to a deficiency rate. It would be a case of taxation without representation. Mr. Harper's table was misleading, although not intentionally so. He had taken the annual value of the premises chargeable to the water-rate, whereas obviously he ought to have taken the annual value of the premises supplied with water. If he had done this, the inequalities of rating shown would have disappeared. The principle of apportioning a deficiency rate according to the benefit received seemed to be a fair one, and the adoption of any other principle would in the case of outside London do great injustice.

Lord LLANDAFF: You abandon that when you leave out the rural districts which do receive a part of the benefit.

Mr. FITZGERALD: No; on the contrary, I insist upon it, because, so far as you are going to levy a rate under the Bill, that will be levied according to the benefit received.

The Committee-room was then cleared. On the public being re-admitted,

The CHAIRMAN said: The Committee have decided to reject both of these amendments—the first one (to insert words) by an equality of votes, and the other (to leave out the last part of sub-section 2), by a considerable majority.

Certain verbal amendments consequential upon previous decisions of the Committee were agreed to.

Mr. FITZGERALD next moved to strike out of sub-section 4 the sentence (c), and substitute words here printed in italics, so as to read: "The amount required by any such precept shall be raised out of (*a*) in the case of the City, the consolidated rate; (*b*) in the case of a parish in a Metropolitan Borough, the general rates; (*c*) *in the case of a municipal borough or urban district the fund or rate out of which the expenses of the Council incurred in the execution of the Public Health Acts are payable.*" The words of (*c*) deleted were "in any other parish, the poor-rate." The learned Counsel explained that the object of this amendment was to give the Railway Companies the benefit of the decision of the Committee, that in case of a deficiency they were to be rated outside London in the same manner as they were rated under the Public Health Act, 1875. It also extended the exemption to the Canal Companies, if any (he believed there was one), and to the agricultural lands and other hereditaments which got the exemption under the Public Health Act. The Railway Companys objected to the framing of the amendment, and wished it to read, "in the case of a municipal borough or urban district, the district fund or general district rate." Section 207 of the Public Health Act read: "All expenses incurred or payable by an urban authority in the execution of this Act, and not otherwise provided for, shall be charged on and defrayed out of a district fund and general district rate leviable by them under this Act, subject to the following exceptions." Then followed three cases of exceptions, which the words of the amendment proposed by the Local Government Board were framed to meet. The Railway Companies were afraid there might be an improvement rate from which they got no exemption at present; and if the deficiency rate were payable out of the improvement rate in the district in which it was leviable, they would get no exemption. He did not think they were entitled to any under such circumstances. The argument before the Committee, and to which they acceded, was that, inasmuch as the Public Health Act was in force outside the limits of the Metropolis, and they had the benefit of the Public Health Act and the exemption under the general district rate, they ought to have it in the case of any deficiency rate. But should there be a case in existence in the area outside London in which at present, under the existing law, the Railway Companies were rated to their full extent for sanitary expenses, there was no reason why that state of things should be altered by the present Bill. He believed that they were fighting about a shadow, and that it made no difference whatever which way the amendment was expressed.

Mr. BALFOUR BROWNE, on behalf of the Railway Companies, said it was not quite fair. When the matter was previously discussed, Mr. Ram (on behalf of the Local Government Board) had made a suggestion that it should be done by saying the rate should be levied on the district as part of the general district rate outside London. This was what he (the learned Counsel), and what the Committee, had accepted. Now, at the last moment, his friends wished to alter the whole thing again. If there were a district which had not got the general district rate, it could easily get it under section 208 of the Public Health Act.

The CHAIRMAN said the object of the decision of the Committee on a former occasion was that they wished to preserve the general law of rating and exemptions, both in London and in the country. They did not wish to bring in a new law for either.

Mr. FITZGERALD said the whole point was this: The decision of the Committee was that existing exemptions were to be maintained. There might be a case where one of the exceptions in the Public Health Act applied, and where there was no general district rate but an improvement rate; and if there were such a case, it must be dealt with. Mr. Balfour Browne had suggested that they should apply to the Local Government Board to turn the improvement rate into a general district rate; but this might be undesirable for a great variety of reasons—for instance, with regard to the incidence of the improvement rate. The Local Government Board had endeavoured to make the decision of the Committee apply to every case which might exist. There was no real danger to the Railway Companies at all.

The CHAIRMAN (after a brief consultation) said the Committee would take the Local Government Board's amendment.

Mr. FITZGERALD then moved the following amendment, which he said was to meet the question which had been discussed with the Westminster Corporation: "The Water Board shall not reduce the rates charged for the supply of water below those in force during the quarter ending June 24, 1902, if such a reduction would, or would be likely to, cause a deficiency in the water fund."

Mr. BLENNERHASSETT, on behalf of the Corporation of Westminster, accepted the amendment.

Mr. BALFOUR BROWNE, speaking for the London County Council, said the Committee had precluded them from arguing the matter, but he protested against the amendment.

The amendment was thereupon agreed to, and clause 11, as amended, was passed.

Twenty-Second Day—Thursday, June 12.

On the resumption of the inquiry this morning,

Lord ROBERT CECIL asked to be allowed to state to the Committee the attitude of the Corporation of London with regard to the Bill. The Corporation had always felt that there was considerable difficulty with reference to the supply of water in London, owing to the system on which it was paid for, and that the more just method would have been payment by meter. They had never been able to see why water should be treated differently from any other commodity, which was that one paid for what one had. At the same time, they felt that, on the present Bill, the matter could not properly be brought forward; and they only desired it to be known that they had not receded from their previously expressed opinion, and their determination to raise the question when opportunity arose.

Mr. PEMBER, on clause 13, brought up a seventh schedule, dealing with the case of the debenture holders of the Companies.

The CHAIRMAN said he understood the position was this: When the schedule was brought up, the Committee was impressed with the fact, with regard to the case of the debenture holders, that they were obliged compulsorily to take stock; and there was a discussion as to whether there should be regulations put in for their protection.

Mr. PEMBER said this was so; and the Chairman had asked the Local Government Board whether there was any objection to adopting a schedule of a similar nature to that which regulated the London County Council stock. Mr. Fitzgerald had replied that he could not answer that question at once, but would inquire. The Chairman had then stated that the Committee were in favour of elasticity of arrangements within proper limits, so far as concerned the water stock which was to be given for ordinary shares. They recognized that it was a great advantage that the two stocks should be the same both for ordinary shareholders and debenture holders. The Chairman added that some members of the Committee were impressed with the possible hardship of the debenture holders not knowing before the Bill left Parliament what were the conditions on which they were to take stock. It was in consequence of this declaration that he now brought forward the seventh schedule with certain alterations, in order to meet the view of the Committee.

Mr. FITZGERALD said that the Local Government Board had considered the question whether it would be possible to insert a schedule in the Bill dealing with the matter in a similar way to that adopted by the London County Council in connection with their stock. But they had come to the conclusion that they could not give the matter sufficient time and care, before the Bill left the Committee, to have a complete schedule of regulations of which they thoroughly approved; and therefore they asked the Committee to leave clause 13 as it stood, and regulations would be framed by the Local Government Board under section 52 of the Public Health Act Amendment Act, 1890.

Mr. PEMBER, on behalf of the Water Companies, asked the Committee not to go back upon their previous expression of opinion, but to consider the schedule proposed by them on its merits.

The CHAIRMAN said that primarily the Committee had to decide the question of the policy of putting the schedule in at all. He had been asked to see Lord Morley upon this point, and had done so; and, as a matter of general policy, the authorities of the House were opposed to inserting any regulations in a Bill of this kind. They stated that they had not been in any Private Bill since 1890, except in the case of an Edinburgh Bill. In a Bristol Bill, although they thought there was a case for it, they decided to adhere to the general policy, and leave the regulations to be framed under the Act of 1890.

The Committee having deliberated in private on the point,

The CHAIRMAN announced that the Committee were not prepared to accept the schedule of conditions, but wished to have inserted in the Bill a provision making it obligatory that the conditions with regard to the two kinds of stock should be identical, except as to the periods of redemption.

On clause 18 ("Arbitration"),

Mr. FITZGERALD brought up a new sub-section (7), in substitution for the one in the Bill, as follows:—

Every award, order, and other instrument made by or proceeding from the Court of Arbitration under this Act shall be binding and conclusive to and for all intents and purposes, and shall have the like effect, as if it had been made by a Judge of the High Court, and shall be acted upon, obeyed, executed, and enforced accordingly. The Court may make one or more awards dealing with the matters referred to them. The Court of Arbitration may state their award or any part thereof in the form of a special case for *the opinion of* the Court of Appeal, and may at any stage of the proceedings at an arbitration, and shall if so directed by the Court of Appeal, state in the form of a special case for the opinion of the Court of Appeal any question of law arising in the course of the arbitration, and an appeal shall, *with the leave of the Court of Appeal, but not otherwise*, lie from the Court of Appeal to the House of Lords; but subject to any order made by the House of Lords in accordance with the Appellate Jurisdiction Act, 1876, every such appeal shall be brought, within two months after the decision appealed against is pronounced by the Court of Appeal, if the House of Lords is then sitting, or, if not, within fourteen days after the House of Lords next sits.

With regard to the words printed in italics, the London County Council, with the agreement of the Water Companies, proposed to substitute "determination by" for "the opinion of," and to delete "with the leave of the Court of Appeal, but not otherwise." They also proposed to add at the end of the sub-section: "The Court of Arbitration shall act in accordance with the decision arrived at in any such case."

Mr. FITZGERALD stated, with regard to the words necessitating the leave of the Court of Appeal before an appeal could be made to the House of Lords, that it might be assumed that where there was any question involving a substantial amount, the Court of Appeal would, as a matter of course, give leave; but if the appeal were of a frivolous or unsubstantial character, they would not. There was nothing unusual in a provision of the kind. It existed in bankruptcy cases.

Mr. THESIGER said it was obviously right that the provision should exist in bankruptcy cases; but in a case like the present, surely the Water Board on the one hand and the Water Companies on the other might be trusted not to take up frivolous points to the ultimate Court of Appeal.

Mr. PEMBER agreed with the arguments of Mr. Thesiger.

Lord LLANDAFF: My experience of these inquiries leads me to think that such a point as this might be raised—viz., whether the Water Companies have exceeded their statutory powers in the rates they have charged; and this would be a question of law of the very greatest importance.

Mr. DANCKWERTS, on behalf of the Chelsea Water Company, asked the Committee also to give the Court of Appeal power to deal with costs. He submitted words to deal with this matter.

Mr. FITZGERALD objected to the alterations proposed. If it were thought advisable by the Committee, words could be introduced with regard to costs, giving the Court of Appeal power to deal with them.

The Committee-room was cleared. On the re admission of the public,

The CHAIRMAN said: Taking the Local Government Board amendment as the basis, the Committee will insert it; but they put in the words "determination by" instead of "the opinion of." The appeal stands with the leave of the Court of Appeal as printed in the amendment; but at the end of the sub-section these words will come in: "The Court of Arbitration shall act in accordance with the decision arrived at in any such case." The Committee do not accept the amendment of Mr. Danckwerts, but adopt the suggestion by Mr. Fitzgerald that words shall be put in giving the Court of Appeal power to deal with the costs.

Mr. RAM brought up a small verbal amendment, adding the words here printed in italics: "The Court may make such allowance. . . for expenses incurred in consequence of the passing of this Act by any Metropolitan Water Company *or the shareholders or stockholders therein*," &c.

In response to a suggestion by Mr. BAGGALLAY, who pointed out that the New River Company had no shareholders or stockholders in the ordinary sense of the term, it was agreed that a definition clause should be inserted so that they might be included in the term.

The amendment was then agreed to, and clause 18, as amended, was passed.

Mr. BAGGALLAY brought up the following proviso in clause 23 as a matter of machinery: "Provided always that it shall not be obligatory to fill up any vacancy in the office of director occurring after the appointed day, and it shall be lawful for the continuing directors for the time being to exercise all powers of directors up to and until the dissolution of the Company."

This proviso was agreed to.

On clause 36 ("Existing officers and servants"),

Mr. BAGGALLAY said the question of compensating Mr. Hunter had not been mentioned. He proposed that words should also be added including compensation for the case of an officer who "is required to perform duties that are not analogous, or whose salary is reduced." This point had been forgotten in the framing of the clause.

Mr. *Walter Hunter*, Engineering Director of the Grand Junction Water Company, was then recalled. He stated that he was under agreement with the Company, and he felt certain that owing to the services he had rendered, he would ultimately be retired on a pension equal to two-thirds his emoluments; and he asked that a pension based upon this scale of his average remuneration for five years preceding the transfer of the undertaking should be secured to him under the Bill, if he ceased to be an officer of the Water Board.

The CHAIRMAN: Is the matter agreed, except with regard to Mr. Hunter?

Mr. BAGGALLAY: No, my lord. One matter is that I want to insert after the words "dismissed by the Water Board on any ground other than misconduct," the words "or who is required to perform duties that are not analcgous, or whose salary is reduced." This case is not provided for. These words are merely to ensure that a man shall not lose his compensation because the Board keep him in his post for a certain time, and then place him in different conditions. The other amendment I propose is after the words "old age," in sub-section 9, to insert "and who has attained the age of 60 years;" otherwise there is nothing to prescribe the time of life at which a man may take advantage of this. I do not think the Superannuation Act covers it.

The Committee agreed to insert words dealing with the case of Mr. Hunter on the lines proposed; to adopt the amendment suggested by Mr. Baggallay, to delete the words "old age," and insert "or who has attained the age of 60 years;" and with regard to the amendment to add the words, "or who is required to perform duties that are not analogous, or whose salary is reduced."

The CHAIRMAN said the provisions of sub-sections 3 and 4 must be read together. If the Water Board at any time abolished the office, or caused extra duties to be put on, the man might relinquish his service. If he relinquished his service he would get his compensation under sub-section 4. The words proposed would therefore be rejected by the Committee.

Mr. FITZGERALD moved to insert in the sixth schedule, giving a list of the enactments repealed, the repeal of sections 11 and 12 of the Croydon Corporation Act, 1884, in order to bring Croydon into the present Act; and it was agreed to.

Mr. RAM then brought up a new clause to continue the provisions for securing a pure supply of water, to which a sub-section was appended as follows:—

If Sir William Crookes and Professor James Dewar, or either of them, are or is, immediately before the appointed day, employed in making examinations or experiments as to the condition of works on behalf of the Metropolitan Water Companies, they or he shall, as from that date, be transferred to the Water Board, and shall, for the purpose of compensation, be deemed existing officers, or an existing officer, within the meaning of this Act.

Mr. BAGGALLAY said that Professor Dewar was very anxious to explain why he thought the first part of the clause would not effect the object he had in view when giving his evidence with regard to carrying on the examinations of the water.

Professor *Dewar* was then recalled, and, in answer to Mr. BAGGALLAY, said the clause mixed up the chemical and bacteriological examination with the other duties now performed by the Water Examiners. There was not a word in it about the continuance of the chemical and bactericlogical examination. Apart from this, the Local Government Board, under the Metropolis Water Act of 1871, were really umpires with regard to water. An appeal could be made by the householders, and they were entitled under the Act to appoint any person to examine into the water supply of any one Company. If this were to be altered, the Local Government Board were to do two things—they were to be the persons to whom the community might appeal, and also the arbitrators. According to this, all the initiative of the department, which had been created after years of labour, was to be dominated by some person or other; and this would completely annihilate all its initiative, suggestion, and maintenance. It was putting the complete power into the hands of the Local Government Board. It was essential, in the best interests of the community, that the system of checking by two separate analysts, as independent officers, should be maintained. He proposed the following clause:—

That the Water Board shall cause to be made, as heretofore, chemical and bacteriological examinations and experiments on the character of the water to be supplied by them, and for this purpose Sir William Crookes and Professor James Dewar, if they are immediately before the appointed day employed in making any such examinations on behalf of the Metropolitan Water Companies, shall, as from that date, be transferred to the Water Board, and shall, for the purposes of compensation, be deemed to be existing officers within the meaning of this Act.

The CHAIRMAN said he was anxious to secure that the examination should be continued; but there had been no statutory obligation heretofore that "the Water Company should supply," and so on, without any regulating authority as to what was competent and sufficient. He was by no means satisfied with the Local Government Board's clause. The words "shall supply a completely equipped laboratory" were far too wide.

In cross-examination by Mr. RAM, witness said he objected to the clause because the Water Board ought to have as independent a department as any other manufacturer; and that it ought to be left by the Board in the hands of that department, as it had been by the Water Companies. He further objected to the authority given to the Local Government Board as to the appointment and removal of persons employed to make examinations. This was giving them the absolute power and control, and, further, prescribing what the nature of the examinations and experiments was to be.

The CHAIRMAN: Supposing the scientific department makes entirely extravagant demands, who is to keep them in order?

Witness: I think the Water Board would be able to do so. They would not make extravagant demands.

The CHAIRMAN said that, according to the way in which the regulations were framed, they would make the Local Government Board practically the purveyors of water to the Metropolis; and this would be a very dangerous power to give.

Mr. RAM said, if the matter were left over, they would most carefully consider what his Lordship had said, and what modifications could be proposed.

Twenty-Third Day—Friday, June 13.

On the reassembling of the Committee this morning,

The CHAIRMAN said he had taken the opportunity of consulting the Committee on the new clause under consideration, and they felt that, whatever might be the case for the proposals in it, they should not be mixed up with the clause putting Sir William Crookes and Professor Dewar into the position of existing officers, into which they were to be put.

Mr. BAGGALLAY said that the clause dealing with the matter proposed by the Local Government Board was satisfactory, and it could be inserted as sub-section 8a of clause 36.

This part of the clause, as printed in the previous day's proceedings, was agreed to be inserted as suggested, the last word, "Act," being altered to "section."

Mr. RAM then brought up a new clause in substitution for that proposed on the preceding day, as follows:—

(1) The Water Board shall cause to be made chemical and bacteriological examinations and experiments as to the condition of the water to be supplied by them, and the effect of storage and filtration, in such manner as the Local Government Board may prescribe. (2) The Water Board shall supply such buildings, apparatus, and plant, and construct such works, as the Local Government Board may require, for enabling such examinations and experiments to be conducted efficiently. (3) The persons employed by the Water Board to make examinations and experiments under this section shall periodically report to the Water Board the result of their examinations and experiments, and a copy of the report shall at the same time be sent to the Water Examiner. (4) The Water Board shall take and record such observations as may be required by the Local Government Board. (5) The Water Examiner shall at all reasonable times have free access to the works of the Water Board for the purpose of inspecting those works, and shall have all proper facilities for making such inspection.

Mr. RAM said the clause had been altered as above in order to meet the views of the Committee.

Mr. BAGGALLAY moved to amend the clause by striking out all the words after "supplied by them" in sub-section 1, and to make sub-section 2 read as follows: "The Water Board shall supply such buildings, apparatus, and plant, and such staff, and construct such works, as may be required for enabling such examinations and experiments to be conducted efficiently." He did not propose to alter sub-section 3, but moved that sub-sections 4 and 5 should be struck out. The proper policy was to make the matter independent of the Local Government Board, and for the Water Board to have the statutory obligation.

The CHAIRMAN remarked that to leave out sub-section 4 would "tread on his toes" very much, because this was the distinct recommendation in paragraph 180 of the report for which he was responsible. It was one of the things which should have been done long ago. They ought to have distinct and accurate statistics as to the effect of pumping the water out of the chalk in all places from which London was supplied with water.

Mr. BAGGALLAY said he had had an opportunity of speaking to Professor Dewar on the matter, and accordingly withdrew his objections to sub-sections 4 and 5.

Mr. RAM said he would call Mr. Perrin with regard to the clause.

Mr. *Charles Perrin*, the Official Water Examiner under the Metropolis Water Act, 1871, was then called. In answer to Mr. RAM, he said all the matters asked for in the clause should be granted, in order to secure the efficient examination of the purity of the water. It would be necessary to have a laboratory established at several of the works where one did not exist, and to carry out an exhaustive series of experiments. It was necessary also to have chemists and bacteriologists who would give their time to the examination of water on the spot. Some bacteriological standard of effectual filtration should be fixed. In Germany, rules were issued with which all water companies had to comply. There would be no harm in the Government specifying certain limits. A bacteriological standard of purity had been more or less fixed by Professor Koch, but it was purely arbitrary. Investigation should be made to see whether the same standard should be applied in England, where there was no standard at present. It was known that if too great a head was put on a filter it was apt to disturb the microbes lying on the surface of the sand, and the water then went through improperly purified. Only a series of experiments could determine what the maximum head should be. Similarly with regard to the "life" of a filter. This was a thing which he believed had never been properly investigated. It appeared to him that some period must arrive when all the materials should be taken out, cleaned, and replaced.

Mr. RAM: I suppose under this heading you would include the thickness of sand used in the filter, and the rate of filtration?

Witness: I regard the rate of filtration as the most important of all. This has been fixed by Professor Koch at about 50 gallons per square foot in 24 hours; but I think a place like London should not simply follow the example of other countries and large towns, but should lead in scientific matters of this sort. Then with regard to the storage of water, Lord Llandaff in his report said it was imperative that all water should be passed through a storage reservoir before being put into the filter-beds. Before carrying out this recommendation, it must be ascertained how many days' storage such a reservoir would be equal to, in order to procure proper sedimentation. Examination must be daily—even hourly in some cases. We want to determine whether a filter must run to waste for a certain number of hours after being cleaned before it is used again. To do this we must make hourly examinations of the water.

How many examinations are necessary?—Four—the first, as it leaves the river; the second, as it passes into the storage reservoir; the third, as it gets on to the top of the filter; and the fourth, as it leaves the filter.

These matters should be under the superintendence of the Water Examiner?—I think the specialists should carry out the examination on their own lines; but the Water Examiner should be able to say what class of experiments is necessary. It is most necessary that the bacteriological examination of the water should be made at the works. It is now carried long distances before it is examined.

The CHAIRMAN: We are not examining into the efficiency of the present system so much as laying down regulations for the future. I want to ask whether you have carefully considered the difference between making a Government Department responsible for doing this work, or taking up what I personally think would be the wiser position—of seeing that somebody else is responsible for doing it, and does it. I am a little afraid that sub-section 2 will really put the Local Government Board into such a position that if anything goes wrong in the future the Water Board will be able to turn upon them and say: "You have not laid down sufficient regulations. The responsibility is yours and not ours." I am sure it is the wisest course to leave the responsibility relatively where it is at present. The Water Companies are responsible, and the Local Government Board puts machinery at their disposal, and sees they do their work. I speak strongly in regard to a Government Department, of which I know some of the difficulties, that you should not attempt to administer a matter of this kind, but should see that somebody else administers it efficiently.

Mr. RAM said they had considered this matter carefully, and there was no desire to alter the incidence of responsibility more than could be helped; but at the same time it seemed to them that somebody must be responsible for the laying down of regulations.

The CHAIRMAN: I am rather inclined to think that the clause as amended by Mr. Baggallay makes it quite distinct that the position which we wish you to take up is taken up.

Mr. RAM said the difficulty was the words "as may be required." By whom?

Lord LLANDAFF: As may be required for efficiency.

Mr. BAGGALLAY (in cross-examination): Do you want to prescribe what the experiments are to be?

Witness: I want to prescribe the direction they should take.

If you do that, and they turn out not to give the information required, you would be responsible for the want of information, would you not?—I suppose one would suggest another series.

Is it not better that the statute should place upon the Water Board, the obligation to make chemical and bacteriological examinations, and any other examination thought proper by Parliament, and that then, if the reports are sent to you, you should be able to judge whether or not the water is being supplied in a pure and wholesome condition, and bring the pressure of the Metropolis Water Acts to bear upon the Board?—I do not see how you can compel the Board to carry out a series of experiments.

In further cross-examination, witness said that, if the water in the mains in London and the area of supply was found to be good, they would desire to go further if the experiment showed that it can be made still better. They knew the water was invariably good. If the Local Government Board found a cause of complaint, they would call upon the Water Companies, or upon the Water Board in the future, to remove it. But at present he did not know when an individual filter went wrong. He acknowledged that under the Metropolis Water Act 1897, any person, with the financial assistance of a local authority, could proceed against the suppliers of water if it was not sent out pure and wholesome; but he did not see how they could tell when an individual well broke down.

Mr. RAM having addressed the Committee in favour of the clause,

The CHAIRMAN said they did not mistrust the Local Government Board, or suppose they would impose absurd regulations; but the point in the minds of the Committee was, as a matter of high policy, whether a Government Department ought to accept an initial responsibility, or whether it ought not to remain—armed with sufficient powers, no doubt—as the watcher over another authority.

Mr. RAM said this point had been carefully considered by the Local Government Board, and the clause was the result of deliberation.

The Committee-room was cleared. On the re-admission of the public,

The CHAIRMAN said the Committee had, by a majority, resolved to insert the clause in the amended form proposed by Mr. Baggallay.

On Schedule V.,

Mr. PEMBER brought up a schedule on behalf of the Water Companies, which, he said, proposed that, within three months after the ascertainment of any compensation to which a Metropolitan Water Company became entitled, the Directors should prepare a scheme for its distribution. The Directors were to send a copy of the scheme to every shareholder, and if within one month anyone holding shares or stock to the value of not less than £20,000 should require it to be submitted to a meeting, one should be summoned. If a majority in value of the shareholders by resolution dissented from the scheme, the matter should be submitted by petition to the Chancery Division of the High Court, which should make an order on the matter. Any such order, or the scheme itself if not objected to, should have effect as if it were enacted by the Act. The part of the clause relating to costs provided that the Water Board should pay the costs and expenses incurred by the Company, or by any shareholders, in any proceedings in the Court under the schedule, except so far as the Court might otherwise order. In the event of their not being settled by the Court, they were to be assessed by the Board of Trade. The learned Counsel contended that it would be far better to let the Court decide the costs of the case which it had heard than the Arbitrators, who had not heard it. This was the only part objected to by the Local Government Board.

Mr. FITZGERALD said the contention of the Water Companies all along had been that a clause should be inserted in the Bill giving them the costs, whereas the Local Government Board maintained that the matter should be left to the discretion of the Arbitrators. Clause 18 covered the whole matter. The last words were: "The Court may make such allowance as they think just for . . . . covering any expenses which have been, or are likely to be, incurred by any Metro-

politan Water Company, or the shareholders or stockholders therein, in consequence of the passing of this Act, and which ought, in the opinion of the Court, to be borne by the Water Board."

Mr. THESIGER said the London County Council supported the view which Mr. Fitzgerald had put forward. Such a clause as that proposed opened up a prospect of very serious costs being incurred, over which the Water Board might have no control whatever.

The Committee having deliberated in private,

The CHAIRMAN said: The Committee accept the fifth schedule, with the exception of the clause about costs. On the particular form as proposed with regard to costs, the Committee were unanimously against it; and on a substituted form proposed by a member of the Committee, there was a majority against inserting anything in substitution of the clause deleted.

Mr. FITZGERALD then stated that, in accordance with a decision of the Committee, the Local Government Board proposed to add to subsection 3 of clause 13 the following words: "And the regulations in respect of water stock issued to the holders of irredeemable debenture stock shall be uniform with the regulations in respect of other water stock, except as to the period of redemption and the provisions relating thereto." He said the Committee would recollect that the irredeemable debenture holders got sixty years.

The amendment was agreed to.

The CHAIRMAN said that he understood that after the words in clause 13, "such a rate, not exceeding 3 per centum per annum, as the Water Board, with the consent of the Local Government Board," the words "and after consultation with the Governor of the Bank of England may resolve," were to stand.

Mr. RICKARDS said he had asked the Committee to strike out those words, but no decision had been given.

The CHAIRMAN said it was a consultative provision only, and did not bind the Water Board. The only point was that if the Governor's advice were rejected, the responsibility of the Board would be greater. He thought the opinion of the Committee was that the words should stand.

This was the last matter to be disposed of, and the Bill was ordered to be reported.

LEGAL INTELLIGENCE.

Winding up the Notkin Syndicate, Limited.

In the First Division of the Court of Session on the 10th inst., a joint note was presented for Mr. C. S. Romanes, the Liquidator of the Notkin Syndicate, Limited, and the petitioners—Messrs. A. Mathieson and Sons, Limited, edge tool manufacturers, Glasgow, and Messrs. James Booth and Co., Sheepcote Street Tube and Rolling Mills, Birmingham—in a petition asking that a voluntary liquidation of the Syndicate, which had been agreed upon, should be made a judicial one. The Syndicate was incorporated on March 12, 1901, and the registered office was at 13, George Street, Edinburgh. The principal object was to acquire and work the letters patent of an invention for an improvement in apparatus for automatically and continuously carburetting air for illuminating and heating purposes, granted to Naum Notkin, and vested in William Thompson Purves, of Edinburgh. The nominal capital was £10,000, divided into 10,000 shares of £1 each. The shares subscribed for, including vendors' shares, numbered 4345. Calls of £1 were made upon 3745 shares; and the remaining 600 were issued as fully-paid. There were calls in arrear to the amount of £37 10s. The Syndicate had not been successful. It had recently sustained losses; its capital was exhausted; and it was unable to carry on business any longer. Messrs. Mathieson and Sons were creditors of the Syndicate to the amount of £67 17s. 5d., and Messrs. James Booth and Co. to the amount of £16 16s. 9d.—both debts being for goods supplied. Decree had been obtained against the Syndicate in the Sheriff Court at Edinburgh, and diligence was being done against the plant and machinery of the Syndicate at Swinton Row, in that city. In the note, the Court were asked to grant the petition, and to appoint a Judicial Liquidator. This was done—Mr. Romanes being selected.

Winding Up of Phos, Limited.

Last Tuesday, Mr. Justice Buckley had before him a petition by Messrs. Falk, Stadelmann, and Co., for the compulsory winding up of the above-named Company, which was formed for the supply of acetylene lamps for omnibuses. In March last, the Company was insolvent, and voluntary winding up was decided upon—Mr. Chantry, the Company's Accountant, being appointed Liquidator, and at the same time Trustee for the debenture holders. It was submitted for the Company that a scheme of reconstruction had been considered, and that there was a prospect of the concern being disposed of if the petition were dismissed. His Lordship granted the petition; remarking that the position of the Liquidator, who was bound in this capacity to dispute the claims made by the debenture holders, while as their Trustee he had to support them, was justification for his decision.

Discharge of Residuals from Gas-Works.

In the Second Division of the Court of Session last Thursday, Counsel were heard in an appeal by the pursuers in an action raised in the Sheriff Court at Oban by the Magistrates of the town against the Callander and Oban Railway Company. The Corporation are owners of about 10 acres of land, which lies to the east of a plot of ground belonging to the Railway Company, upon which they have erected gas-works—a wall separating the two properties. It is stated that some time ago the Railway Company made a hole in this wall, and discharged through it, on to the property of the Corporation, the liquid residual products from their gas manufacturing operations. To this, the Corporation objected; and the Company promised to remove the cause of the complaint. It is said, however, that they entered upon the Corporation ground and laid a 4-inch drain of fire-clay pipes, through which they discharge residual liquors upon the surface of the Corporation property. The Corporation seek interdict of the discharge, and an order on the Company to remove the drain. The Company say that between the properties there is a road which they formed long prior to the Corporation acquiring their land, and which they have the right to use, and have all along used. The surface water from their property naturally drains towards that of the Corporation; and it has done so since 1879, through a hole in the wall, which was left for the purpose. At the time the Corporation complained, some tar had escaped from the gas-works through the hole, owing to an accident. In order to prevent the escape of tar or other residuals, the Company, in February, 1901, erected a separating tank inside the wall, on their own ground, into which all the surface water collecting on their ground flows, and the water from the tank is led by the pipe through the wall and under the road. It is all pure surface water, and it is maintained that the Company are entitled to a servitude over the Corporation ground for the outlet of the surface drainage of their own ground. Sheriff-Substitute MacLachlan found it to be admitted by the Company that they discharged water from the tank on to the Corporation grounds, and that the Corporation were not bound to allow it. He granted perpetual interdict. He considered it to be obvious that the overflow from a separating tank could not possibly be pure surface water. Sheriff Ferguson recalled the decision, and ordered proof. He considered that, in view of the averment that all the water discharged was surface water, there ought to be inquiry into the disputed facts before the drastic remedy of perpetual interdict could be applied. When the case came to the Court of Session, Counsel for the Corporation said they did not object to the proof, but they asked that it should be taken in Edinburgh, before one of their Lordships, instead of before the Sheriff-Substitute at Oban. The Court considered that the Sheriff Court was the proper tribunal for the trial of the case; and they refused the appeal, with expenses.

The Fracas at the Dublin Gas-Testing Station.

In the "JOURNAL" for the 27th ult., a report appeared of two cases heard by the Recorder of Dublin, which arose out of a disturbance at the testing-station between Mr. T. J. Cotton (the Gas Examiner to the Dublin Corporation) and Mr. J. W. Brent (who represented the Gas Company during the tests). They were cross actions; and in the result the Recorder awarded Mr. Cotton £40 damages, and dismissed Mr. Brent's claim. This judgment was appealed against; and on Monday of last week the matter came before Mr. Justice Kenny, who, after hearing evidence on both sides, dismissed the appeals. In the course of his judgment, his Lordship said what was the precise duty Mr. Brent had, when he did attend at the testing, he was not in a position to state; but under no circumstances was he to interfere with the testing of the gas by the Corporation Gas Examiner. What he had to decide did not depend upon the past relations of the parties, unless as affording a motive for a very serious assault; and therefore he dismissed them altogether. He had heard the evidence of the three persons present; and he could not believe that all this occurred as the result of a mere scrimmage in which one person tried to take away a chair and another to retain it. The evidence was all one way. The Recorder was absolutely right in his decision in both cases; and the sum awarded was not excessive. He would give witnesses' costs.

Prepayment Meter Agreements.

A man was charged at the Gateshead Police Court on Monday of last week with damaging a meter belonging to the Gas Company, and also with refusing to pay for gas supplied. Mr. Corke, for the prosecution, said that the case had been adjourned from the previous week, the defendant having denied his wife's signature on the agreement. Defendant had left the house without giving the required notice to the Company; and in the meantime some boys had broken into the place and taken the money from the penny-in-the-slot box and damaged the meter. The Company sued for 9d. and 2s. 6d. damage. Those who had the meters were bound by their agreements to give the Company at least three days' notice before leaving. One of the employees of the Company said that the man's wife signed the agreement for her husband in witness's presence. Defendant stated that his wife did not know a letter of the alphabet. Witness replied that many of the women could not write; but they could manage to scrawl their names. Defendant's wife, who was sworn, said that she could not write. The man had signed it himself. The Chairman of the Bench (Major Dance) said that was a serious charge to make. They believed the Gas Company's man, who knew what such conduct meant. The Bench inflicted a fine of 1s. and costs and 2s. 6d. for the damage, and ordered the payment of the missing 9d. Other similar cases were then taken. During the hearing of one of them, Mr. Lambert, the Clerk, asked why the husbands were not got to sign the agreements. Mr. Corke replied that they were difficult to find in. Mr. Lambert asked what would be the result if the husbands repudiated authority. Mr. Corke said that gas was a necessary; and the husbands had shared in the use of the light. Mr. Lambert remarked that there was such a thing as candle light. One of the cases was dismissed, and the other was adjourned to permit of the appearance of the husband concerned.

Heywood and Middleton Water Board.—The annual report of the Heywood and Middleton Water Board states that the total expenditure for the year on revenue account amounted to £24,018, and the deficiency on profit and loss account to £1892. Provision has been made for sinking funds amounting to £2874. The deficiency twelve months ago was £1254; and it is explained that the increased charges against revenue for rates and taxes (£244), and also the interest on the Nayden higher reservoir works (£694), are responsible for the increased deficiency. The receipts for water sold for domestic purposes show an increase of £275 over the preceding year. The expenditure on capital account during the past year was: Ashworth Moor new works, £19,091; and Nayden higher reservoir enlargement, £4914.

MISCELLANEOUS NEWS.

GAS CONSUMERS' COMPLAINTS AT PERTH.

Report by Mr. Thomas Newbigging.

Mr. T. Newbigging, of Manchester, has issued his report with regard to his investigation into the alleged increase of gas bills in Perth, to which reference has been made on several occasions by our Scotch correspondent. The following are the principal points in the document:

It appears that 97 complaints in writing by consumers were sent in, and Mr. Newbigging devoted the greater part of the week ending the 31st ult. to their investigation; personally interviewing about 40 of the parties. The total number of gas consumers being 8800, the written complaints were about 1·1 per cent. of the whole. The number of verbal complaints, however, he was informed, was very much larger than the written ones. That there had been a very general advance in the amounts of the gas bills for the quarter ending April, 1902, was quite true. In a number of cases, it was trivial; but in the instances of many of those who had sent in written complaints, it was very considerable. In his opinion, the causes of the general increase were not far to seek; but in particular cases they were more difficult to determine. For example, in some special instances the increase was 30, 50, and even 100 per cent., although, as strongly asserted by the complainants, there had not been any addition to the number of their burners or other appliances for gas consumption, or in the number of hours during which the consumption had taken place. Some of them even asserted that they had reduced the number of the burners during the period in question. The meters in the majority of cases had been tested, and in most instances found to be correct. In some cases where they had been found incorrect and in excess, the percentage allowance for such excess did not reduce the bills to anything like the amount recorded for the corresponding quarter last year. In some instances, leakages from the internal fittings had been discovered; but these were comparatively few. In the case of the heavier increases which had taken place without apparent reason, the question had been put to him by the interviewers: "How do you account for this?" His answer was: "Accepting your assurance and your statements, I cannot account for it." In making this admission, however, he did not admit the case for the complainants. He asserted without hesitation that even in the most extreme and apparently inexplicable instances of increases which had been brought to his notice, the quantity of gas registered had passed through the meter, and had been consumed, wasted, or lost by leakage after so passing. He did not question the *bona fides* of any complaining consumer. He simply said that he was mistaken. If that answer did not satisfy him, he could not help it; and it would probably not satisfy him if he still clung to his mistaken views. No other explanation could be given, and no other was required.

Passing on to deal with pressures, Mr. Newbigging expresses the opinion that they were reasonable and moderate. It was no fair criterion to point to the lower pressures which sufficed in past years, as the conditions were altogether changed. A higher pressure than formerly was now required in order to ensure the efficient action of the numerous cooking and heating stoves and gas-engines in use as well as the greater and growing number of lighting consumers. Mr. Newbigging points out that this is a matter which the consumer can himself regulate by means of a governor. Some of the consumers—though he was bound to say not many of those who laid their complaints before him—thought there was something "radically wrong with the meters." This was not an uncommon fallacy; but, as a matter of fact, there was not a more honest measuring instrument than a gas-meter. The meter was the arbiter between the consumer and the Corporation. If on its being tested it was found correct, any excess in the bill was due to the gas having been consumed or lost by leakage from the consumer's fittings. To accept any other arbiter would be to introduce chaos into the conduct of the gas undertaking. It was really its honesty as a measurer that had given the meter its bad reputation. There was no more excellent indicator of carelessness or extravagance in the usage of gas than the meter. Mr. Newbigging was gravely told that air was being "forced or pumped into the pipes, so as to make the meters go faster." He heard of the existence of a surreptitious pipe being laid to allow of the gas being sent into the city direct from the holders, without having the pressure controlled by the governors, and charges of "bad gas" were common. There was no ground for any of these suspicions. As to bad gas, he found none during his week's stay in Perth. On the contrary, he found, on testing it, that it had an illuminating power fully equal to that recorded—higher, indeed, than, in his opinion, was either necessary or desirable. The coal and cannel used in producing the gas were of such quality as to preclude the notion of a low illuminating power. Even the virgin gas obtained from the coals, having an illuminating power of about 23 standard sperm candles, was further (needlessly, as he thought) enriched with benzol to the extent of about 2 candles. It was hinted to him more than once in the course of his investigations that the gas was improved during, and owing to, his visit. He had no reason to suspect anything of the kind. The average illuminating power for the past three years was 25·34 candles. Some of those who complained of bad gas referred, in proof of their statements, to the fact that the ceilings of their rooms were fouled with smoky deposits. This was really a proof of the richness of the gas, and that it was being consumed with unsuitable burners.

On the general question of increased gas consumption in Perth, leaving out of account the exceptional cases to which he had referred, Mr. Newbigging says there were ample grounds to account for it. He pointed out that, in a run of good times and brisk trade, gas bills, like most others, had a tendency to go up in amount. There was a more lavish consumption, and less care was exercised in checking waste; but when the inevitable lull in trade arrived, the impetus given to gas consumption went on unheeded and unchecked until the bill came in at the end of the quarter. Then there was a sudden awakening among consumers, and a plethora of complaints came into the gas department, or were poured into the ears of the gas collectors and inspectors. A good official knew how to discriminate between grumblings about the amount of bills and complaints that had some real apparent ground; and he, as a rule, took all or most of such grumblings with a grain of salt. To show how exaggerated the statements were that had been bruited abroad, even in quarters where one would least expect them, Mr. Newbigging cites the following facts:—

In an official statement containing replies to certain queries I handed in to the Gas Commissioners, it is said, in answer to my query as to the percentage of complaints that have been lodged, that 60 per cent. of the consumers to the south and 70 per cent. of those to the north of the High Street have complained. A statement of this kind is absurd in face of the actual facts which I have found, and the reasonable and normal increase in the general consumption. They could not have been complaints in the true sense of the word, but only grumblings of persons having to pay their accounts, and no official note need have been taken of them. That the statement is a gross exaggeration, is evident from the fact that the total increase in the gas consumption by private consumers for the year 1901-2 (excluding the public lamps) is only 8·11 per cent. over the previous year. In point of fact, the increase is less than in 1900-1, when it was 8·44 per cent., and in 1899-1900, when the increase was actually 10 per cent. True, in 1901-2, a number of the consumers resolved to adopt electric lighting, abandoning, or partially abandoning, the use of gas for lighting; and if account be taken of this fact, provided there were no other compensating circumstances, the increase would be more than 8·11 per cent. But there is a compensating circumstance, and I call attention to the striking fact that no fewer than 1300 cooking and heating appliances have been added during the year. It is not possible to say exactly what the consumption has been by these, but I think I am justified in saying that it may well be set against the loss of consumption due to the changes to electricity for lighting in lieu of gas. Again, it was explained to me, both by the Gas Treasurer and the Gas Inspectors, that the quarter ending in January last was 12 to 15 days longer than the corresponding quarter of last year, due to the circumstance that the inspectors began to take the state of the meters a week earlier; and the completion of this work was delayed about a week longer, by reason of their having also to inspect the electric light meters. I have tried to ascertain the probable gas consumption during the additional time, and I make it out to be about 6,500,000 cubic feet, or 4 per cent. of the whole quantity sold. This, of course, is an estimate, but I believe it to be within the mark; and if account is taken of this, as it certainly ought to be, the percentage increase in the consumption for the normal year will be less than I have stated above. This will help to account for some of the increases that have taken place in the bills of some of the complaining consumers.

In conclusion, Mr. Newbigging expresses the opinion that undue prominence had been given to the comparatively few complaints that had been sent in, and an amount of heat imported into the public discussions in the Council Chamber concerning them. He ventured to say that had the complaints been made to the Manager direct, and not through irregular channels, they would not have reached anything like the present number, few as these were comparatively. His experience was that in the conduct of gas undertakings there was always a considerable percentage of complaints of excess bills sent in. With all the facts before him, and the full consideration he has given to them, he is strongly persuaded that, when all the circumstances are taken into account, the general increase in the bills is fully warranted. Finally, his observations have convinced him that there is no "rule of thumb" working at the Perth Gas-Works. The Council may rest assured of that. He says he has but rarely in his experience seen a gas-works conducted on more scientific principles, or more economically and well. The Perth citizens have reason to be proud of Mr. M'Lusky, their Gas Engineer and Manager; for a more intelligent or more devoted official he has not met with. He is persuaded that there will be no back reckonings in the way of shortage of profits on the year's working while Mr. M'Lusky is at the helm of affairs; and he deserves all the confidence the Council may repose in him.

PLYMOUTH AND STONEHOUSE GAS COMPANY.

The Annual General Meeting of this Company was held last Thursday—Mr. J. A. Bellamy (the Mayor) in the chair.

The Secretary (Mr. H. B. Heath) having read the notice of meeting, the report of the Directors was presented. They stated therein that, notwithstanding the rapid increase in the use of incandescent mantles, which lessened the consumption, and the competition of the electric light, the quantity of gas sold last year was greater than that of the previous year. The price of gas having been reduced from June of last year accounted for the diminution in the receipts for gas in the revenue account, while the fall in the price of house and steam coals lessened the sum realized for coke and breeze. After payment of the authorized dividend in January last, interest on debenture stock and to the bankers, and carrying £2000 to the suspense account, there remained to the credit of profit and loss account the sum of £20,285 10s., from which the Directors recommended the payment of a dividend for the half year ending the 31st of March last of 5¾ per cent. on the ordinary stock, 9s. per share on the additional shares, and 8s. 6d. per share on the new shares under the Act of 1879, less income-tax. This would absorb £7443 17s. 10d., and leave a balance of £12,841 12s. 2d. to be carried to the credit of the next account. The directors expressed their pleasure to report that, owing to the very favourable oil contracts, as well as to reduced charges for coals and freight, they had given notice of a reduction in the price of gas to 1s. 9d. per 1000 cubic feet as from March last. This would enable them to pay the statutory increase in dividends as provided for by the sliding-scale.

The Chairman, in moving the adoption of the report, said the Directors met the shareholders under very happy circumstances, as the report was a highly satisfactory one. The undertaking stood upon rock foundation, and was in a far better position than it had occupied for many years. It was curious to observe that from 1889 to 1899, with the exception of the two years 1894 and 1895, the Company practically did not earn the dividends paid, but took a little each year from the reserve to make up the dividend—the price of gas being 1s. 9d. per 1000 cubic feet. They had just had two years of high-priced coals, and were powerless to do anything to economize; but they had got over that time of trouble. Coals were now down practically to their normal level, and so also was oil, which had become an

important factor in the manufacture of gas. They were consequently in the happy position of having made very satisfactory contracts both with regard to coal and oil, and they had gone a step further, and made another contract for oil for next year upon very favourable terms, so as to make themselves quite safe with regard to the future and the price of gas. In 1882, they sold 325 million cubic feet of gas; in 1892, 585 millions, and in 1902, 873 millions. These figures were really astonishing, and showed the steady progress made by the Company. He had taken out figures which, apart from the first cost of the article, showed the cost of converting that article into gas. In 1892 it cost 6·991d. per 1000 cubic feet to produce the gas. This was the cost on the works, leaving out the first cost of the article. Last year it was only 4·745d.—a saving of 32 per cent. on the cost of production as compared with 1892. This fact should satisfy the shareholders that while the concern was progressing in its business, the Directors were looking after the kernel of the situation at the works by seeing that the gas was produced at as low a cost as possible. Ten years ago in one year they laid 2505 yards of main; last year they laid 9757 yards; and the year before 7997 yards. From these figures they would see that the work done had enormously increased, and demanded greater care and supervision. They introduced a short time ago the question of cookers. The Directors recognized the absolute necessity of devoting their attention to heating and cooking as purposes for which gas was extensively used, especially in view of the competition they had to face from the electric light. This was already a successful branch of their business. They had 2536 cookers on hire, apart from slot-meter cookers, which numbered 7554; and they were still going on. There was a large demand for cookers. Taking all things together, they had been enabled to reduce the price of gas to the old figure of 1s. 9d. per 1000 cubic feet; and he had not the slightest doubt that would continue, or at all events it would not increase. Personally, he was ambitious to bring the figure down to 1s. 6d. per 1000 cubic feet. Looking at what was before them, he believed that in a very short time they would be able to supply gas in Plymouth at this low price. Having referred to the revolution which has taken place in connection with gas lighting by the introduction of the incandescent system, and to the sanctioning by Parliament of a lower illuminating power gas in the Metropolis, the Chairman went on to refer to the naphthalene question. He said that up to now this evil seemed to be incurable. The Company had spent money in experiments at the works, and brought about improvement; but they could not effect a cure. Last year the Directors determined to get at the bottom of the matter. They recognized that the gas must be supplied in such a way that the enormous number of complaints received with regard to naphthalene should be entirely wiped out. Naphthalene was the bugbear of the gas industry; but they thought they had at last solved the problem. Mr. Hoyte, their Engineer, had made experiments with a small plant, and had succeeded in extracting the naphthalene at the works; and they had come to the conclusion that if it was extracted before the gas went into the pipes, it could not cause any mischief afterwards. They had abandoned all other methods of attempting to remedy the evil after the gas had gone into the mains, and were treating the gas at the works, so that it might be sent out with the naphthalene extracted. He hoped and believed it would be an entire success. They did not wish to be too sanguine; but the experiments so far made had been absolutely conclusive, and they could not foresee any trouble, when the entire plant was erected, in completing the cure. Practically, the Plymouth Gas Company would be the first in the country to adopt this particular method. There were some companies which professed to have effected a cure in another way; but they had tried these other methods at Plymouth, and had found the cost to be so great that they had to abandon them. After working the thing out, and making full inquiry, they had come to the conclusion that the system about to be adopted was the right one, and would get rid of this trouble once for all. After briefly alluding to the fresh issue of stock the Company were making, the Chairman referred to the position of the employees. He said the officials had loyally done their best in the interest of the Company throughout the year; and he was glad to say that the relations between the Board and the workmen were most happy. During the past twelve months there had not been a solitary grievance between the Directors and the men. The Directors had done their best to meet the reasonable wishes of the men in every way. When he joined the Board, there seemed to be some antagonism existing, and when the Chairman was seen on the works he was looked upon as an interloper and an enemy. But all this feeling had passed away. It must tend to promote the prosperity of such an undertaking when the workmen and Directors were working hand in hand for its improvement. If his forecast of the uture of the Company was correct, he should propose to the Directors to give the workmen an addition to their wages. When the price of gas was again reduced, it would be a record time; and it would be for the Company to let the workmen come in and share the extra prosperity. He had no doubt that when the time arrived they would be unanimous in the desire to treat the workmen in a fair and reasonable manner.

Mr. J. WILLS seconded the motion, and it was carried.

It was then resolved to declare a dividend for the six months ending the 31st of March at the rate of 5¾ per cent. per annum on the ordinary stock, 9s. per share on the additional shares, and 8s. 6d. per share on the new shares, in addition to the authorized half-yearly dividend paid in January last, less income-tax; and the Directors were empowered to pay the shareholders on the 1st of January next a dividend at the rate of 6⅛ per cent. per annum on the ordinary stock, 9s. 9d. per share on the additional shares, and 9s. 3d. per share on the new shares for the six months ending Sept. 30 next, less income-tax, on account of the dividend to be declared at the next annual meeting.

On the motion of Mr. R. WOOLLAND, seconded by Mr. GREEK WILLS, and cordially supported by Mr. H. A. WILLEY, the annual sum of £300 was granted to the Chairman, in addition to the usual amount voted to the Directors, in consideration of his great services to the Company.

The CHAIRMAN, in returning thanks, expressed the hope that the Company had many years of prosperity before them, and that the confidence reposed in him would not be misplaced.

A vote of thanks was then passed to the Chairman and Directors, and the proceedings closed.

EXAMINATIONS IN GAS MANUFACTURE.

The Pass List.

We have just received from Sir Philip Magnus, the Superintendent of Technological Examinations of the City and Guilds of London Institute, a copy of the Pass List in the recent "Gas Manufacture" examination; but so far no intimation has been given of who are the prize winners in the two grades. The names of the successful candidates are as follows.

HONOURS GRADE.

First Class.

Bairstow, H. M.	Creed, E. C.	Mayne, G. F. W.	Tatam, G. W. G.
Brettle, J.	Dyer, G. H.	Nisbett, A. S.	Thorman, J. S.
Brooke, T.	Hardcastle, F.	Ramsden, R. S.	Walmsley, P. D.
Burroughes, B. H.	Hollingsworth, D.V.	Scarth, P. F.	Ward, F. E.
Cowper-Smith, M. G.	Hutchinson, E.	Scears, E.	Whyte, J. N.
	Lang, J.	Simpson, J.	Wimhurst, F. L.

Second Class.

Anderson, G. W.	Farquhar, W. B.	Nuttall, L. W.	Thomson, W.
Bottomley, J. W.	Forrester, H. A.	Phillips, E. T.	Townsley, J.
Burton, W. A.	Galbraith, W.	Ruggles, H. G.	Turner, A.
Clapham, T. A.	Ingham, R.	Sargent, T. H.	White, W. A.
Cooke, P. W.	Mitchley, J. W.	Stiven, D. D.	Wilkinson, H.

ORDINARY GRADE.

First Class.

Allen, P. T.	Chew, J. H.	Legge, H.	Stevens, J. R.
Anderson, A.	Clark, G. J.	Lockey, R.	Stoddart, R. T.
Ashurst, G. E.	Clarry, R. G.	Lockey, W.	Tobey, R. S.
Atkinson, R. L.	Critchley, T.	Lowe, T. G.	Upton, W.
Banks, H.	Crossley, S.	M'Call, W.	Valon, W. M'I.
Beaumont, T. H.	Darkin, B. D.	M'Gregor, A.	Walsh, M. J.
Bedford, P.	Duncan, G. J.	M'Kinley, R.	Walton, W.
Bell, W. R.	Gregson, W.	Milne, S.	Warren, W. H.
Boxall, W. H.	Hankin, M. H.	Mitchell, J.	Watson, P. B.
Boyd, G. W.	Hanson, W.	Moon, J. C.	Watts, J. S.
Broadhead, F.	Harris, G.	O'Mahony, J. J.	Webster, J.
Brockway, F.	Harvey, D. H.	Price, D. H.	Wedd, F.
Brook, R. M.	Hazell, H. D.	Robinson, F. H.	Whimster, J. G.
Brown, R. H.	Herman, W. J.	Scholefield, F.	White, J. P.
Burton, H.	Hindle, H.	Scholefield, J.	Whittell, J.
Butterfield, H.	Keillor, J.	Shellswell, J. W.	Whyte, W. J.
Chalmers, R. B.	King, C. G. C.	Shenton, G. H.	Wilson, A.
Chesterman, W. C.	Larkin, F. S.	Smith, C. E.	Wilson, H.

Second Class.

Brockley, C. W.	Fligg, G. W.	M'Crae, J. P.	Sanderson, W.
Brown, P. J.	Furniss, T. E.	Nichols, F. T.	Spurway, O.
Brown, T. H.	Gomersall, W.	North, A.	Stephenson, J.
Chester, W. H.	Higgs, H. C.	Orr, T.	Taylor, B.
Clark, P. B.	Howlett, H. J.	Prince, O.	Thomas, A.
Coe, J.	Hutchinson, C. W.	Rice, J. W.	Thomas, A. R.
Cooper, C.	Hutchinson, E. G.	Richford, J. W.	Walmsley, G.
Donaldson, P. M.	Jeffs, H. A.	Robinson, F.	Watson, J.
Duckenfield, G. W.	Littlewood, H.	Rust, J.	Williamson, J.
Evans, E.			

DUNDEE GAS AND ELECTRICITY SUPPLY.

Annual Accounts—Resignation of the Gas Manager.

The Statutory Annual Meeting of the Dundee Gas Corporation was held last Wednesday—Lord Provost HUNTER presiding—to consider the annual accounts of the Corporation. A summary of them has already been given in the "JOURNAL."

Treasurer RITCHIE, in his annual statement, said the estimated revenue in the Gas Department was £108,839; whereas the actual revenue had been £114,343, showing an increase of £5504. They had received £4980 more for gas than they anticipated; and chemical products, &c., had yielded £1743 more. On the other hand, coke was less by £1219. The estimated expenditure for the year was £108,028; the actual outlay had been £122,043—an increase of £14,015. For this the following accounts were mainly responsible: Coals, £5806; wages, &c., £4478; purifying, £430; main and service pipe repairs, £504; gas apparatus and tools, £1346; sinking fund, £1450. The quantity of gas manufactured was 658 million cubic feet, against an estimate of 612 millions; making an increase of 46 millions over the estimate. To sum up, the total income was, as he said, £114,343, and the expenditure £122,043; showing a deficiency of £7700 on the year's working. Coming to the electricity accounts, he said the estimated revenue was £20,382, while the actual had been £18,616; showing a deficiency of £1766. The estimated expenditure was £19,531; the actual, £18,398—being £1132 below the estimate. In the Gas Department, the revenue from all sources was put at £117,327, and the expenditure at £114,006; showing an estimated surplus of £3320. The revenue was made up as follows: Gas, £100,826; chemical products, £10,000; coke, £6300; coal-waggon revenue, &c., £201. The expenditure he gave under the following heads: Balance from April 30, 1902, £7700; manufacture of gas, £63,055; distribution, £3800; rents, rates, taxes, &c., £7440; management, £3460; annuities, £6400; interest, £8300; expense of loans, £100; sinking fund, £9750; contingent fund, £4000. As regarded the Electricity Department, the revenue, including the balance brought forward, was estimated at £25,914, and the expenditure at £25,667; showing an estimated surplus of £247. The revenue was made up as follows: Balance from April 30, 1902, £217; electricity for private lighting, £15,967; private motors, £600; public lamps, £1005; and tramways, £8125. The items of expenditure were: Generation of energy, £9720; distribution of energy, £975; public lighting, £370; rents, rates, taxes, &c., £2650; management, £1352; interest, £5000; sinking fund, £2800; contingent fund, £2800. Referring to the figures, he said the Council would easily understand his reticence at that juncture in dealing with the accounts and estimates in detail. The latter, he thought, should be adopted as submitted. Provided the retorts

were made right in time, he predicted favourable results for the current year. It was, however, impossible just now for anyone to say with confidence how matters might turn out. In any case, from the system of returns they proposed to adopt, they would soon learn if the yield of gas was what it ought to be. The increase in the Electricity Department outside the tramways was very satisfactory; and the only change they proposed to make in the price was the reduction of ½d. per unit for motive power. He suggested that the price of gas be charged as follows: To the consumers in Dundee, 3s. 6d. per 1000 cubic feet; in Invergowrie, 4s. 6d.; in Downfield, 4s. 6d.; harbour lamps, 3s. 6d.; Esplanade lamps, 3s. 6d.; Downfield lamps, 4s. 6d.—all subject to a discount of 5 per cent. if paid within 28 days after the accounts are rendered; to the Dundee Town Council (police administration), for gas supplied to the public lamps, 3s. 4d. per 1000 cubic feet without discount; and for gas consumed through automatic meters, 3s. 9½d. per 1000 cubic feet net. He further proposed that the price of electric energy to ordinary consumers, except by agreement and for motive power, per quarter should be as follows: For any amount up to 20 units, 6s. 8d.; for each unit above, 4d.; consumers who take over 10,000 units to be charged 3d. per unit above such 10,000—subject in all cases to discount at the rate of 5 per cent. to all consumers who pay their accounts within 28 days after they are rendered. He also moved that the public lamps should be charged at the net rate of £15 each for those burning the whole night, and £7 10s. each for those burning part of the night, and that electrical energy for motive power should be charged for 60 units or under per quarter a minimum of 7s. 6d.; above 60 units, 1½d. per unit if taken through separate meter, but otherwise the ordinary rate of 4d. per unit—subject in all cases to 5 per cent. discount if paid within 28 days.

Mr. BALLINGALL, in seconding the motion, explained, with respect to the estimates, that he took no responsibility. They were drawn up by the Manager.

The LORD PROVOST, in reply to a question by Mr. Nairn, said that in future a weekly statement of the Gas Department was to be submitted to the Convener of the Gas Committee, and a monthly statement to the Committee, so they would see how matters went on.

Bailie ROBERTSON complained of the short time afforded to members for consideration of the accounts, and went on to refer to the differential rate applicable to electricity employed for lighting and for motive power. Why the Board who made a distinction of this kind as regards electricity should refuse to do it with respect to gas was a mystery to him. He supposed it would continue just as long as the consumers of gas for motive power were patient enough to bear it without making an outcry. Because of the high rate charged for gas for heating and cooking purposes, many people had returned their stoves, and many had refrained from taking them for this reason. Inasmuch as separate meters were employed, there would be no difficulty in making a differential rate for gas used for lighting, heating, and motive power. He hoped that by next year the Treasurer would consider the necessity of giving relief to the class of consumers he had indicated.

Mr. NAIRN pointed out that electricity could be produced cheaply throughout the day for motive power, when there was no demand for it as an illuminant, and that it was economical that the engines at the station should not be allowed to stand during the day. Unlike gas, electricity could not be economically stored; and this was why it was expedient to offer it at a cheaper rate.

Mr. HIGH remarked that this was all very true; but it had to be kept in mind that they were reducing electricity 25 per cent. in opposition to their own gas-works. What, he asked, was the good of one department taking the feet from another? He thought the proposal was very foolish, whoever framed it.

Mr. URQUHART pointed out that it was proposed, from the profits made by the gas concern, to wipe off a deficit of £7700, and wind up the year with the comfortable balance of over £3000. The Commissioners had never been furnished with any data to lead them to suppose for one moment that these expectations would be anything like fulfilled. How were they to believe, when last year they spent £61,000 on coal, that next year they were to produce a larger quantity of gas, and make a greater profit, on £52,000 worth? He, like Bailie Robertson, complained of the short time given to members to consider the estimates, which were most essential things to be considered carefully, because it was upon them that they could either praise or blame their Manager. It was not fair to the management, and it was certainly not fair to the Commission itself, that these figures should be in a haphazard way put into the estimates, bringing out a surplus of £3320, when members were perfectly satisfied in their own minds that no such surplus would ever be attained. He hoped that next year they would not have the Convener of the Gas Committee and Treasurer Ritchie both absolutely repudiating responsibility for the estimates.

Bailie STEVENSON, referring to the relative prices of electricity and gas, said he quite agreed with Mr. High that they should not run the one against the other. As for the Electricity Department, he thought the accounts should be looked into closely. They should be providing for depreciation, and he wished to know if the Treasurer was perfectly satisfied that enough was being done in that respect.

Treasurer RITCHIE said last year they put aside £1700 to depreciation, and it was now proposed to turn this into a contingency fund. The Engineer was satisfied that they were doing all that was necessary to maintain the station in a proper state.

The accounts and estimates were approved.

The CLERK (Sir T. Thornton) submitted the following letter from Mr. W. M'Crae, the Engineer and Manager:—

Referring to the conversation I had this afternoon with Lord Provost Hunter and ex-Provosts Ballingall and Brownlee, and Treasurer Ritchie, I hereby beg to hand you my resignation as Engineer and Manager of your Gas Department. At the same time, I would point out that I do so, not because I feel conscious of having ever neglected your interests, but only because it is evident that my services are no longer appreciated. I have now served the Board for a period of 24 years, and during the portion of that time when I was Assistant-Engineer, and especially during the last six years, when I have been your Chief Engineer and Manager, your interests have at all times been my first consideration.

The TOWN CLERK: I presume you accept this resignation? (Cries of "Agreed.")

The LORD PROVOST suggested that the matter should be remitted to the Committee, and that they should call a meeting at the earliest possible date.

It was stated that a meeting would be called on the following Friday to consider the question of the appointment of a successor to Mr. M'Crae, whose resignation takes effect at once. The decision come to at this meeting will be found recorded in our "Notes from Scotland" to-day.

BATLEY CORPORATION GAS SUPPLY.

According to the annual accounts of the Batley Corporation Gas Department, of which Mr. J. F. Bromley is Manager and Secretary, the quantity of gas sold for private consumption in the borough for the twelve months ending the 31st of March was 127,297,500 cubic feet, which produced a revenue of £16,903; in the township of Soothill, 14,134,000 cubic feet were sold, producing £2061; and 4,115,600 cubic feet were supplied through automatic meters, realizing £686—making a total of £19,650, or with the discounts (£2765) taken off, £16,885. For public lighting purposes, 16,924,000 cubic feet of gas were sold in Batley, Soothill, and Morley—the revenue, including lighting in Morley, being £1330; making a total of £18,215. The sale of residuals produced £6440; and the total receipts were £25,637. The expenditure on the manufacture of gas was £13,345; on distribution, £620; and on management, £835—the total being £16,536. The balance carried to the profit and loss account was therefore £9101. This was disposed of as follows: Interest on loans, £4282; instalment of the sinking fund, £2369; and addition to accumulated profits, £2450—bringing up the total to £9185. But as £2000 was employed in relieving the rates, and £450 was transferred to the contingency fund, there was at the end of the financial year a balance of £6735 to be carried to the balance-sheet.

GAS AND ELECTRIC LIGHTING AT ROCHDALE.

The annual report of the Gas and Electric Light Committee of the Rochdale Corporation has lately been issued. It shows that, after providing for interest and sinking fund, as well as for the cost of the public lighting of the borough, the net profits of the Gas Department amount to £11,885; being £178 less than for the preceding year. There was no contribution to the reserve fund in either period. The Committee state that the contracts for coal sealed in September last were at a reduced price; but one-third of the total quantity used during the year was under the previous contract, and therefore the full effect of the reduction was not felt. In the year 1901-2, the net cost of coal and benzol per ton was 14s. 8·76d., as compared with 15s. 11·87d. in 1900-1—a reduction of 1s. 3·11d. over the whole year. Against this, there has to be set the considerable falling off in the value of tar products and some reduction in the revenue from coke, notwithstanding the increased quantity sold and the receipt of nearly £800 from contractors as compensation for failure to take delivery of that contracted for. In an appendix to the report, it is stated that, assuming the value of the gas supplied for public lighting to be 2s. per 1000 cubic feet, the total cost of the street-lamps for the year is £5578 15s. 10d.

Unfortunately, the consumption of gas has not shown any expansion since the increase in price early in 1900; indeed, for lighting purposes, there has been an actual decrease, in spite of the larger number of meters in use. The Committee say that to some extent this is no doubt attributable to the alteration in price, and also to the adoption of the incandescent system of lighting. In view of the probability of an early reduction in the prices of mantles and burners, and the removal of the restrictions which have hitherto impeded the general use of this system, they think it may reasonably be expected that in the near future they may look forward to a considerable extension of this method of illumination; and it may then be worth while to consider whether it will be advisable to continue the expenditure involved in the enrichment of the gas to its present standard for lighting purposes. The Committee point out that in three instances at least Parliament has already consented to the reduction of illuminating power from 16 to 14 candles; and this policy seems, they say, to be extending, in consequence of the large amount of gas used for purposes other than lighting, for which enrichment adds little or nothing to its value.

In the Electricity Department, the Committee report some progress last year, though it was hardly satisfactory. The number of applications for current was 91, and they were all accepted. With the commencement of the past financial year, the prices were reduced for lighting to 6d. and 2d. per unit on the maximum demand system, or a uniform rate of 4½d.; and for power to 2d. per unit, varying with the quantity consumed to 1½d. Naturally these charges had a considerable effect upon the income; but the Committee consider it is practically certain that, had they not been made, few, if any, consumers, would have been connected, and possibly some of those already connected would have discontinued the use of electricity. The applications for power may be considered as the result of adopting a more suitable charge.

SMETHWICK CORPORATION GAS SUPPLY.

Profits Near Vanishing Point.

The annual report and statement of accounts of the Gas Department of the Smethwick Corporation for the year ended the 31st of March last has just been issued by the Secretary (Mr. W. J. Sturgess). It sets forth that the borrowing powers were increased during the year, under the provisions of the Smethwick Corporation Act, 1901, whereby the Corporation are empowered to borrow an additional sum of £89,000 for the purposes of the gas undertaking. The total amount borrowed at the end of the year was £201,463; and the total outstanding debt on the undertaking at the close of the year was £189,182. The capital outlay increased during the year to the extent of £3435; making the total expenditure £189,929. The actual capital employed is equal to £6 17s. 8d. per ton of coal carbonized, or 13s. 5d. per 1000

cubic feet of gas sold. These figures, which will be increased next year, when the extensions now in contemplation are completed, compare unfavourably with the average for the whole of the gas-works belonging to local authorities in the United Kingdom, which, according to the latest returns of the Board of Trade, works out to £5 15s. per ton of coal carbonized, or 11s. 11d. per 1000 cubic feet of gas sold. The increase in the sale of gas was again of a very satisfactory character; the total quantity sold being 298,281,700 cubic feet, compared with 275,163,000 cubic feet in the previous year—an increase of 8·4 per cent. The quantity of gas sold through prepayment meters was 25,608,800 cubic feet, against 18,550,000 cubic feet in the preceding year; being an increase of 38 per cent. The quantity of gas sold for motive power and heating purposes was 41,729,400 cubic feet, against 20,534,200 cubic feet in the previous year—an increase of 103 per cent. On the other hand, the gas used by ordinary consumers appeared to be less by 5,460,800 cubic feet, or 2½ per cent. This was not, however, an actual decrease, but was due to the fact that from Midsummer last gas for heating purposes had been charged in the same schedule as that supplied for motive power, which in the previous year was included in the ordinary consumption. The income from prepayment meters was £4268, against £3091. The total income from the sale of gas amounted to £36,734, compared with £37,588 for the previous year. The reduction of 3d. per 1000 cubic feet in the price of gas which took place from Michaelmas quarter last diminished the income by £1796; while the reduction in the charge for gas for motive power and heating had resulted in a further diminution of £994. The number of meters in use at the end of the year was 5666—an increase of 95 ordinary and 711 prepayment. The aggregate income from all sources was £47,565. The cost of manufacturing gas worked out to 20s. 10d. per ton of coal carbonized, against 21s. 11d. for the previous year and 16s. 10d. for 1899. The quantity of gas produced per ton was 10,966 cubic feet, against 10,707 cubic feet for 1901—an increase of 259 cubic feet per ton. The gross profit for the year amounted to £9042. After meeting the usual charges for interest, repayment of loans, &c., the surplus remaining was only £285—the net profit for the year. The causes of this falling off are explained to be these: While the price of coal was lower to the extent of 1s. 6d. per ton, or £2176, the amount received for coke and breeze was £2306 less. The reduction in price represented a loss of income to the extent of £2791; and the parliamentary charges came to £1237. The expenditure on account of the water-gas plant during the year was £3798, which absorbed the balance of £3000 to the credit of the depreciation fund, and left a debit balance of £798, which, together with the remaining expenditure to complete the water-gas plant, has still to be provided for out of the revenue.

The Lighting Committee of the Newcastle Corporation have resolved, on the report of the Lamp Inspector (Mr. Lamb), to try the experiment of automatically lighting and extinguishing 100 lamps in a district to be selected by him.

BURSLEM CORPORATION GAS SUPPLY.

At the last Meeting of the Burslem Town Council, the Chairman of the Gas Committee (Mr. E. Leigh) made his annual statement in regard to the work of the Gas Department in the past financial year. In the course thereof, he stated that during the year the make of gas amounted to 208,319,000 cubic feet, compared with 210,785,000 before. Of this total, 124,927,000 cubic feet had been distributed to private consumers, against 129,205,000 cubic feet, and 40,657,000 cubic feet to users of automatic meters, compared with 33,580,000 cubic feet in the year 1900-1901. For public lighting, the same sum had been put down as before, although a considerable number of new lamps had been supplied; yet regard had been paid to the fact that incandescent burners and mantles had been used. The gas distributed for public lighting amounted to 19,906,000 cubic feet; and on the works (which are under the supervision of Mr. H. Peaty) 2,083,190 cubic feet had been burnt, compared with 2,107,850 cubic feet last year. The gas unaccounted for measured 20,745,404 cubic feet, against 25,985,744 cubic feet. The leakage was equivalent to 9·9 per cent., and in the previous year to 12·3 per cent. The percentage of leakage had caused some alarm, and had led to a very careful investigation of the mains all over the district. Escapes had been discovered in various parts of the town; but these had been remedied, and the leakage had been diminished. The Committee hoped to still further reduce the leakage, and were gradually taking out old and inferior mains. Although there was apparently a reduction of 2 million cubic feet in the quantity of gas produced, if they took into account the saving under the head of leakage they would find that there was an increase of nearly 3 millions. In previous years they had been able to record an increase of from 10 to 11 millions. There were two reasons why there was not that increase last year. In the first place, the cheapness of the incandescent mantle had led to its being more largely used, and had affected the output of gas; in the second, the large consumers had either not burned gas for so long a time, or they had exercised more economy, for there had been very great reductions in the bills of the larger consumers. The Committee had hoped that the introduction of considerable numbers of gas-cookers would have compensated for losses of this kind; and it seemed to him that some alteration would have to be made in the conditions on which these appliances were supplied, so as to fix a reasonable minimum of gas consumption if the use of the cooker was to be allowed to continue. Turning to the cost of gas, Mr. Leigh said that coals had cost £13,732, compared with £14,928 before; showing a saving of £1196. Unfortunately, the saving had been more than absorbed owing to the smaller amount received for residuals, which was £1888 less than in 1900-1, or £700 more than had been saved on coal. While coal had dropped in price by 2s. 6d. per ton, the price of coke had been reduced by 6s. per ton. The receipts, less discounts, amounted to £27,164, against £26,618. The gross amount charged in 1901-2 was £28,400, compared with £28,207—an increase of £193, notwithstanding the fact that less gas had been made than before.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 1776.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
590,000	10	Apl. 11	10½	Alliance & Dublin 10 p.c.	18—19	..	5 10 6
100,000	10	,,	7½	Do. 7 p.c.	13—14	..	5 7 2
300,000	100	Jan. 2	5	Australian 5 p.c. Deb. .	100—102	..	4 18 0
200,000	5	May 14	6½	Bombay, Ltd. . . .	6—6½	..	5 0 0
40,000	5	,,	6½	Do. New, £4 paid	4¼—4⅝	..	5 9 5
380,000	Stk.	Feb. 13	12	Brentford Consolidated	255—260	..	4 12 4
270,000	,,	,,	9	Do. New . . .	188—193	..	4 13 3
50,000	,,	,,	5	Do. 5 p.c. Pref. .	128—133	..	3 15 2
206,250	,,	June 12	4	Do. 4 p.c. Deb. .	111—114	..	3 10 2
220,000	Stk.	Mar. 13	10	Brighton & Hove Orig.	205—210	..	4 15 3
246,320	,,	,,	7	Do. A. Ord. Stk. .	148—153	..	4 11 6
420,000	20	Apl. 11	10	British.	40½—41½	..	4 16 5
50,000	10	Feb. 13	12	Bromley, Ord. 10 p.c. .	23—25	..	4 16 0
82,850	10	,,	9	Do. 7 p.c. . . .	18—20	..	4 10 0
500,000	10	May 14	6	Buenos Ayres (New) Ltd.	9½—10¾	..	5 14 3
220,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb.	96—98	+1½	4 1 8
150,000	20	Mar. 13	8½	Cagliari, Ltd. . . .	21—23	..	7 3 6
100,000	10	June 12	10	Cape Town & Dis., Ltd.	15—16	..	6 5 0
50,000	50	May 2	6	Do. 6 p.c. 1st Mort.	54—56	..	5 7 2
550,000	Stk.	Apl. 11	12	Commercial Old Stock	265—270	..	4 8 11
236,425	,,	,,	9	Do. New do. .	205—210	..	4 5 9
238,237	,,	June 12	4½	Do. 4½ p.c. Deb.	130—134	..	3 7 2
800,000	Stk.	May 28	8	Continental Union, Ltd.	137—142	..	5 12 8
200,000	,,	,,	7	Do. 7 p.c. Pref.	150—155	..	4 10 4
575,000	Stk.	Feb. 27	5	Crystal Palace Ord. 5 p.c.	120—125	..	4 0 0
60,000	,,	,,	5	Do. 5 p.c. Pref. .	122—127	..	3 18 9
91,140	,,	—	5	Do. 5 p.c. Deb. Stk.	140—143	..	3 9 11
486,090	10	Jan. 30	10½	European, Ltd. . . .	18½—19½	..	5 7 8
354,060	10	,,	10½	Do. £7 10s. paid	13½—14½	..	5 8 8
15,243,200	Stk.	Feb. 13	4⅛	Gas- 4 p.c. Ord. . .	94—96	..	4 11 8
2,600,000	,,	,,	3½	light 3½ p.c. max. .	89—91	+1	3 16 11
3,799,735	,,	,,	4	and 4 p.c. Con. Pref.	111—113	+3½	3 10 10
4,193,975	,,	June 12	3	Coke 3 p.c. Con. Deb.	91—93	..	3 4 6
70,000	10	Nov. 13	8	Hongkong & China, Ltd.	13—14	..	5 14 4
3,800,000	Stk.	May 14	10	Imperial Continental .	202—205	−2	4 17 7
473,600	Stk.	Feb. 13	3½	Do. 3½ p.c. Deb. Red.	100—102	..	3 8 8
561,000	Stk.	Feb. 27	10	Liverpool United A	220—222	..	4 10 1
718,100	,,	,,	7	Do. do. B .	166—168	..	4 3 4
306,083	,,	Dec. 30	4	Do. do. Deb. Stk.	118—120	..	3 6 8
75,000	5	June 12	5	Malta & Medn., Ltd. .	4¼—4⅝	..	5 5 3
560,000	100	Apl. 1	5	Met. of 5 p.c. Deb.	106—110	..	4 10 11
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	103—105	..	4 5 9
541,920	20	June 12	5½	Monte Video, Ltd. . .	9—10	..	7 0 0
1,595,892	Stk.	Feb. 21	4⅜	Newc'tle & G'tesh'd Con.	105—107	..	4 1 9
346,855	Stk.	Dec. 27	3½	Do. 3½ p.c. Deb.	100—102	..	3 8 8
150,000	5	May 28	8	Oriental, Ltd. . . .	7—7⅛	..	5 6 8
135,000	4½	,,	8	Do.	6—6⅛	..	5 10 9
15,000	1	,,	8	Do.	1¼—1½	..	4 11 5

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
60,000	5	Mar. 13	7	Ottoman, Ltd. . .	6¼—6⅝	..	5 3 8
851,070	10	Apl. 25	7	River Plate Ord. . . .	10—10¼	..	6 13 4
250,000	Stk.	Dec 30	4	Do. 4 p.c. Deb..	95—98	..	4 1 8
250,000	10	Mar. 26	8	San Paulo, Ltd.. . .	12—13	+½	6 3 1
135,000	Stk.	Mar. 13	10	Sheffield A	239—241	..	4 3 0
209,984	,,	,,	10	Do. B	238—240	..	4 3 4
523,498	,,	,,	10	Do. C	237—239	..	4 3 8
5,850,000	Stk.	Feb. 13	5	South Met., 4 p.c. Ord.	122—125	..	4 0 0
1,627,965	,,	Jan. 16	3	Do. 3 p.c. Deb. . .	93—95	..	3 3 2
380,940	Stk.	May 14	5	Southampton Ord. . .	102—106	..	4 14 4
70,825	,,	Jan. 16	4	Do. 4 p.c. Deb.	100—103	..	3 17 8
120,000	Stk.	Feb. 27	5½	Tottenham and Edmonton A. 5 p.c. B. 3½ p.c.	120—125	..	4 8 0
260,520	,,	,,	4		95—100	..	4 0 0
182,380	10	Jan. 16	5	Tuscan, Ltd.. . . .	7—8	..	6 5 0
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	97—100	..	5 0 0
230,000	5	Mar. 13	9	West Ham, 10 p.c. . .	10—11	..	4 1 10
172,000	10	,,	6	Do. 7 p.c. . .	13—14	..	4 5 8
				WATER COMPANIES.			
780,599	Stk.	Dec. 30	11⅛	Chelsea, Ord. . .	305—315	..	3 13 0
150,000	,,	,,	5	Do. 5 p.c. Pref. .	155—160	..	3 2 6
160,000	,,	,,	4½	Do. 4½ p.c. Pref. '75	140—145	..	3 2 1
175,785	,,	Mar. 26	4½	Do. 4½ p.c. Deb. .	140—145	..	3 2 1
1,720,560	Stk.	Mar. 26	8	East London, Ord.. .	210—215	.	3 14 5
654,740	,,	June 12	4½	Do. 4½ p.c. Deb. .	142—147	..	3 1 3
1,018,046	,,	,,	3	Do. 3 p.c. Deb.. .	96—98	..	3 1 3
700,000	50		8	Grand 10 p.c. max..	112—117	..	3 8 5
310,000	Stk.	Mar. 26	4	Junction 4 p.c. Deb..	127—130	..	3 1 7
708,000	Stk.	Feb. 13	16	Kent	295—305	..	5 4 11
160,000	,,	,,	7	Do. New, 7 p.c. max..	200—210	..	3 6 8
1,043,800	100	Dec. 30	10½	Lambeth, 10 p.c. max..	295—305	..	3 8 10
406,200	100	,,	8	Do. 7½ p.c. max..	210—220	..	3 12 9
350,000	Stk.	Mar. 26	4	Do. 4 p.c. Deb..	125—130	..	3 1 7
500,000	100	Feb. 13	12⅛	New River, New Shares	400—410	−5	3 2 5
1,000,000	Stk.	Jan. 30	4	Do. 4 p.c. Deb..	127—132	..	3 0 7
902,300	Stk.	June 12	7	South- wark and Ord. . . . 7½ p.c. max. 5 p.c. Pref. .	188—193	..	3 12 6
126,500	100	,,	7		180—185	..	3 15 8
489,200	Stk.	,,	5		152—157	..	3 3 8
1,019,585	,,	Apl. 11	4	Vauxhall 4 p.c. A Deb.	125—130	..	3 1 7
1,155,066	Stk.	June 12	10	West Middlesex. . .	275—285	..	3 10 2
200,000	,,	,,	4½	Do. 4½ p.c. Deb. .	139—144	..	3 2 6
200,000	,,	Mar. 13	3	Do. 3 p.c. Deb. .	95—97	..	3 1 10

This, he thought, confirmed his statement as to the saving in the leakage. The gross receipts were £35,665, against £36,494. On carbonization, £522 had been saved, which was a vindication of the policy of the Committee in altering their system of stoking. The gross expenditure on the works had been £35,664 0s. 10d., which, deducted from the revenue of £35,665 0s. 11d., gave a profit of £1 0s. 1d. Mr. Leigh drew the attention of the Council to the fact that the figures for public lighting were omitted from the accounts. In view of the fact that they had spent £677 19s. 5d. on public lamps, as well as given the gas free, they were entitled to regard the lighting of the town as equivalent to about £3000. Moreover, they had been acquiring stoves very rapidly, and had thought it right to place a certain proportion of their income to reasonable capital expenditure. They had been enabled to provide the whole cost of the stoves, which was £3907 12s., of which sum they had put £1410 into stock, and provided £2497 12s. out of the year's revenue. It could, therefore, be shown that the net profit amounted to about £6000. Though they had made less gas last year than in the preceding twelve months, it had taken more coal. The quantity of gas made per ton of coal had been reduced in consequence of an inferior kind having been supplied. They had used last year 20,521 tons to make 208,319,000 cubic feet of gas; while in the previous year they carbonized only 20,048 tons to make 210,785,000 cubic feet. In conclusion, Mr. Leigh said the sulphate of ammonia plant had been working six months under unfavourable conditions; but by its use, they had made a profit of £169 15s. 6d. This justified the hope the Committee had held that they would be able, within a short time, to set aside £400 a year out of the profits to be paid to capital expenditure.

GAS AND ELECTRIC LIGHTING AT STAFFORD.

The Past Year's Working.

The Chairman of the Gas and Electricity Committee of the Stafford Corporation (Mr. C. H. Wright) has presented his report on the results of the working in the year ending the 31st of March. It opens with an expression of his pleasure at having to record an increased quantity of business in each department. The total quantity of gas made was 172,248,000 cubic feet, compared with 165,344,000 cubic feet in the preceding year. The leakage and unaccounted-for gas was equal to 4·59 per cent. of the make; being a considerable decrease on that of the year 1900-1. Coals and oil and coke (for the manufacture of carburetted water gas) cost £282 9s. 8d. less than before; and manufacturing charges, &c., were £501 3s. 5d. less. The gas consumed for private lighting yielded an increased revenue of £1452 5s.; while the charges for public lighting were lower by £101 9s. 6d. The net increase in the gas receipts was £1350 15s. 6d. The Chairman reminded the Council that early last year coals rose to an abnormal price, and as a consequence coke prices ruled high. There was very little relief in the prices of coal during the year reported upon; but coke and tar values fell to quite their normal level. As a consequence of this, there was a decrease in the receipts for residual products of no less than £2555 14s. 3d. The gross profit for the year was £8176 18s. 2d., against £8818 18s. 3d. before; being a decrease of £642 0s. 1d. After deducting £1071 for depreciation, £351 4s. 8d. for the proportion of interest on the bank overdraft, £2414 10s. 8d. for interest on loans, £474 2s. 1d. for income-tax, and £3300 0s. 4d. for loans repaid, and including £371 11s. 8d. brought forward, there remained a net balance of £937 12s. 6d. to be dealt with. Of this sum, £750 has already been handed over in aid of the rates, and the Committee propose to carry forward the balance of £187 12s. 6d. Regret is expressed that, notwithstanding the good working results, there will be no available bonus for the workmen this year. The total expenditure on capital account for the gas undertaking is £112,891 14s. 9d., and the capital repaid amounts to £43,158 1s. 9d.; leaving £69,733 13s. owing The total paid out of the profits in reduction of rates, with the present contribution, equals £37,325.

With regard to the Electricity Department, Mr. Wright states that the total revenue for current, meters, rents, &c., amounted last year to £2955 11s. 4d., being an increase of £449 0s. 3d.; and the total expenditure, £2292 7s. 5d. The gross profit is therefore £663 3s. 11d., or an increase of £45 8s. 4d. Interest charges and loans repaid amount to £1517 12s. 5d., and in addition the Committee have decided to place to the depreciation fund for cable and battery renewals the sum of £300. They regret that there is a debit balance on the year's working of £1157 8s. 6d., which, added to last year's balance of £503 4s. 1d., leaves a total deficiency of £1660 12s. 7d.

The report is followed by the accounts of the two departments, which include analyses by the Engineer and Manager (Mr. Hubert Pooley, Assoc.M.Inst.C.E.). In respect of the gas undertaking, the amount owing on the 31st of March was £64,425, which was at the rate of £3 9s. 1d. per ton of coal carbonized, and 7s. 11d. per 1000 cubic feet of gas sold. The coal carbonized and the coal equivalent of the oil and coke used in the manufacture of carburetted water gas was 18,350 tons. The bulk of gas produced was 172,248,000 cubic feet, of which 162,185,381 cubic feet were sold, 2,153,100 cubic feet were used at the offices and works, and 7,909,519 cubic feet were lost by leakage. The quantity of gas made per ton of coal carbonized was 9387 cubic feet. of which 8838 cubic feet were sold, or 94·16 per cent. on the make; the coke produced was 9733 tons 7 cwt.. or (less breeze) 12¼ cwt. per ton, of which 9·33 cwt. were sold; the tar made was 932 tons 9 cwt., and 10·2 gallons per ton of coal were sold; the sulphate of ammonia made was 122 tons 6 cwt., and 17·3 lbs. per ton of coal were sold. The net proceeds of residuals on the cost of coal were 48·2 per cent. The total working expenses of the Gas Department were £8686 1s. 2d.; being 9s. 5·6d. per ton of coal carbonized and 13·51d. per 1000 cubic feet of gas sold. The gross profit was £7105 18s. 2d., or 7s. 8·94d. per ton, and 10·52d. per 1000 cubic feet; the net profit, £566 0s. 10d., or 7·4d. and 0·84d. respectively. Adding the balance brought forward

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raised the net profit to £937 12s. 6d., or 1s. 0·26d. and 1·39d. respectively.

With regard to the electric light undertaking, the capital account stood at £24,240 15s. 2d. at the close of the financial year; being at the rate of £61 per kilowatt capacity. There were 292,727 units generated, of which 240,123 units were sold for private consumption, 5680 for public lighting, 15,660 were used on the works, and 31,264 were not accounted for. The total revenue was £2955 11s. 4d., or 2·89d. per unit sold; the total working expenses were £2595 7s. 5d., or 2·53d. per unit. The gross profit was £360 3s. 11d., or 0·36d. per unit; but as £876 10s. 2d. was required for interest, and £641 2s. 3d. for the repayment of the loans—together, £1517 12s. 5d.—there was a deficit of £1157 8s. 6d., which, added to the previous year's balance, made a total of £1660 12s. 7d. to be carried forward. The proportion of total working expenses to gross revenue is 87 per cent.; the total revenue per kilowatt capacity of the plant is £7 8s. 6d.; the working expenses, £6 10s. 5d.; and the revenue per 8-candle lamp connected, 4s. 8d. The last was the sixth complete year of working of the undertaking.

SALES OF STOCKS AND SHARES.

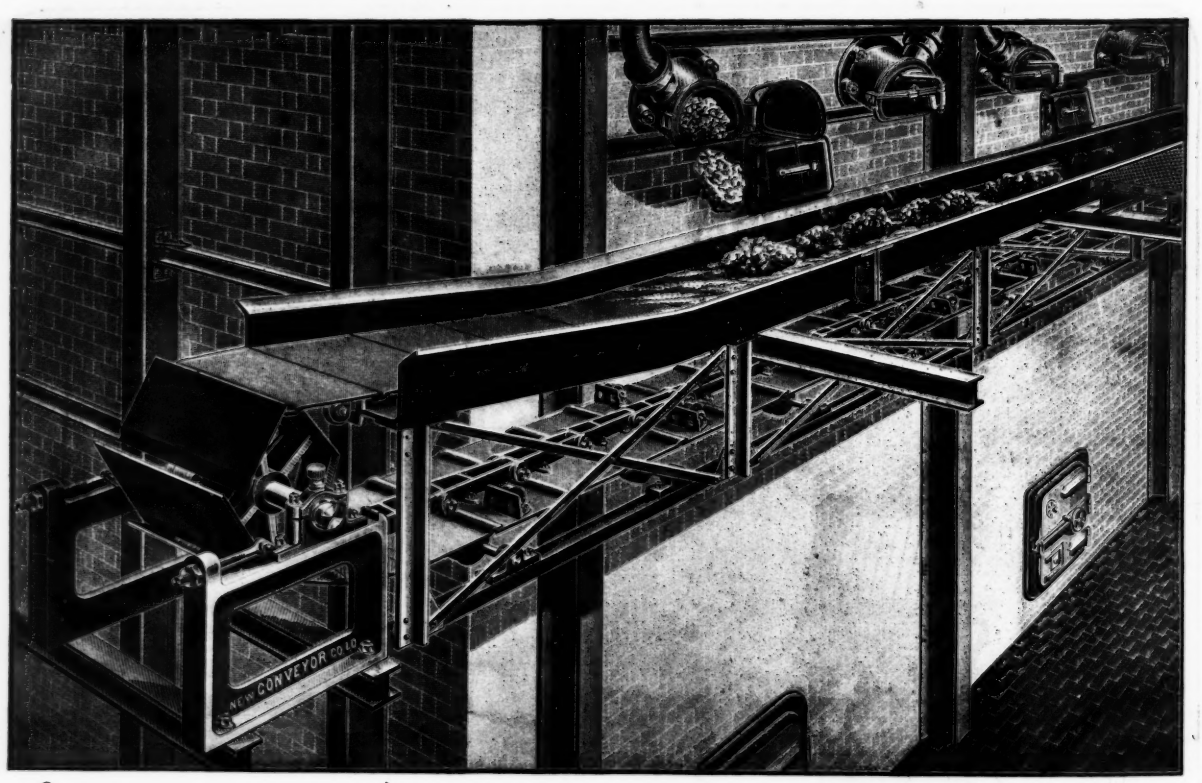
At the Mart, Tokenhouse Yard, last Tuesday, Mr. Alfred Richards conducted a sale of gas and water shares by order of directors and others. The first lots offered consisted of £10 "C" shares in the Harrow and Stanmore Gas Company, ranking for a standard dividend of 7 per cent., subject to the sliding-scale; the last dividend on similar shares having been at the rate of £5 12s. per cent. per annum. They fetched on an average £10 10s. 6d. each, which yielded the investor £5 6s. 7d. per cent. on his investment. He next put up some £10 fully-paid ordinary shares in the West Ham Gas Company (last dividend 6½ per cent.), which were placed at £14 each, yielding the purchaser £4 12s. 10d. per cent. A small parcel of original £5 shares in the same Company, the last dividend on which was at the rate of 9½ per cent. per annum, was sold at £10 per share, returning £4 15s. per cent. A few £10 fully-paid ordinary "A" shares in the Aldershot Gas and Water Company, ranking for a standard dividend of 10 per cent., subject to the sliding-scale (last dividend £11 4s. per cent.), fetched £23 apiece, yielding the buyer £4 17s. 6d. per cent. The next day, Messrs. Cumberland and Sons offered for sale by auction £8000 of new ordinary 5 per cent. stock of the Derby Gas Company. It was put up in lots of £100 each, which were sold at an average premium of £21 10s. each. The total amount realized was £9720 10s. Messrs. Harrison and Sons recently sold ten "E" shares in the Barnsley Gas Company at £15 5s. each, and twelve £2 10s. shares in the Worsbro' Gas Company at £4 2s. 6d. each. At a sale by Messrs. Peirce and Thorpe last Friday, five "A" shares in the Northampton Gas Company realized £44 each; some "B" shares, £18 10s. and £18 15s. each; five "C" shares, £33 5s.; a "D" share, £9 10s.; and five "E" shares, £31 5s.

CHELSEA WATER-WORKS COMPANY.

The Half-Yearly General Meeting of this Company was held at the Office, Commercial Road, Pimlico, last Thursday—Mr. FRANCIS STEPHEN CLAYTON in the chair.

The SECRETARY (Mr. G. H. Gill) having read the notice convening the meeting, and some formal business having been disposed of,

The GOVERNOR proposed the adoption of the report. He stated that the gross income for the half year ended March 31 last had been £93,583, and the working expenses £31,667. The Directors recommended a dividend on the ordinary stock at the same rate as in January—namely, 11½ per cent. The amount applicable to dividend was £86,742; and after deducting the sum required to pay the rate mentioned, £41,858 would remain to be carried forward. This, however, included £4253, which represented the increased value on the investments account. The Company held £10,000 of Metropolitan Consolidated 3½ per cent. stock, £6114 Metropolitan Consolidated 3 per cent. stock, and £12,000 of London and North-Western Railway 3 per cent. debenture stock. Hitherto these investments had appeared in the accounts at cost price; but this was no criterion of their full value. The Directors considered that the time had arrived when this stock should appear in the accounts at something approaching its actual value. They therefore decided that the stock, together with the two sums of Metropolitan Consolidated stock, should appear in the accounts as of the market value on April 1 last. The result had been an increased value of £4253 upon these investments; and since that date there had been a further improvement of £840. In the event, however, of any depreciation in the prices of these stocks—which was improbable, as they were all "gilt-edged"—any future account would, of course, be readjusted accordingly. The expenditure on capital account during the past half year had been £1956, which consisted of £695 expended on extensions of service-mains, &c., in the district, and £1261 for providing and fixing Venturi meters on the mains at the Putney Heath reservoirs, and the erection of a suitable recording house. This latter work had been carried out to give a ready means of ascertaining the exact quantity of water passing daily from the Putney reservoirs into the district. The importance of these Venturi meters would be seen when he stated that any considerable over-rating of the quantity of water actually supplied would prejudicially affect the Company's position with respect to storage reservoirs, and also as regarded the rate of filtration. The experience of the three months' working of these meters, from January 1 to March 31, had been that 8·67 per cent. less water had been pumped than would have been shown by the old method of making the returns—namely, by the engine counters; and during the summer months the difference would be nearly 10 per cent. The average daily supply of the Company for the past three months had been 10,877,000 gallons, which, under the old system, would have been 11,911,000 gallons; being a difference of 1,034,000 gallons per diem. This meant that they had more storage capacity than was supposed, and that the work of filtration was, in



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SOLE MAKERS—

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fact, slower, and therefore more efficient, than appeared under the former method of computation. The quantity of water pumped during the half year was 2203 million gallons, a decrease of 63 million gallons as compared with the quantity pumped in the corresponding period of 1901; the cost of pumping showing the satisfactory saving of £1243. This was due to the reduced price of coal under the contract for the year ending at Midsummer next; and from that date the Directors had been able to make a fresh contract for a further period of one year at a substantial reduction in price. Consequently, for the next two half years, at all events, an additional saving should be effected in the cost of pumping. During the six months, 218 new supplies had been laid on, which were estimated to produce an additional water-rental of £1034 per annum. There had, however, been 114 houses pulled down, entailing an immediate loss of income of £716; but part of this amount was only of a temporary character. There had been 533 yards of service-mains laid during the half year, to meet extensions in the district, principally in Fulham. The Company's part of the work in connection with the scheme of intercommunication had been completed. It consisted of the laying of a 30-inch main from Caledonia Street, Grosvenor Road, Pimlico, to the boundary of the West Middlesex Company's district in the Brompton Road. The debenture stock to meet the cost of this part of the work (about £21,000) would probably be issued towards the end of the present or early in next year. It was satisfactory to know that this work was finished; but at the same time he did not think that there was much risk of any water famine this year, judging from the quantity of rain that had fallen in the last month or two. As regarded the Government Water Bill, the Joint Committee to whom it had been referred had concluded their labours; and the Bill would shortly be considered in Committee of the Whole House, when, doubtless, there would be considerable discussion on the subject, especially on behalf of the London County Council. He thought, however, it might be assumed that the Government would succeed in carrying the Bill through Parliament in the present session, or, it might be, in an autumn session. The Companies had succeeded in obtaining a few amendments in the Bill when before the Committee. The most important one in the interest of the Companies was the postponement of the appointed day from January 1, 1903, to December 25 following, with power to the Local Government Board to extend the time for another eighteen months—namely, to June 24, 1905. It was to be hoped, therefore, that the terms of purchase would be arranged, either by agreement or by arbitration, before the latter date, at all events. The Companies would naturally have preferred that the Arbitrators should have been appointed to settle the matter as under the Lands Clauses Act; but the Legislature appeared to think otherwise. Three eminent gentlemen had been named in the Bill to act as Arbitrators; and there was no reason to doubt that they would deal justly and fairly by the Companies. Anyway, whenever the time came for the Directors to state their case, they would do their utmost to obtain the full value of the undertaking.

The DEPUTY-GOVERNOR (Mr. Jackson Hunt) seconded the motion, which was carried unanimously.

The dividends recommended were afterwards approved—that on the ordinary capital stock being £5 15s. per cent., less income-tax, out of the profits of the Company; being a dividend of 5 per cent. for the half year, and 15s. per cent. extra on account of previous dividends which had fallen short of the statutory yearly rate of 10 per cent.

The retiring Directors (Mr. Clayton, Mr. Alexander Ward, and Mr. Herbert P. Bodkin) were afterwards re-elected, as was also the retiring Auditor (Mr. J. A. Hallett).

Mr. JOHN DREW then proposed a vote of thanks to the Governor and Directors, and warmly recognized the way in which these gentlemen had protected the interests of the Company. He expressed his own hope and belief that the London Water Bill would pass. After all the great expense that had been gone to in defending the interests of the Companies, and the various Commissions that had been appointed, he did not think that any more information was likely to be obtained; and he doubted very much whether the Companies would get better terms than were now offered to them.

The motion was seconded and carried unanimously.

The GOVERNOR, in reply, stated that the Directors had had a very anxious time, and that their anxieties were not yet at rest, because as soon as the Bill was passed they would be busy in getting up the Company's case to submit to the Arbitrators. He warmly commended the services of the Secretary, the Assistant-Secretary, the Chief Engineer, and the latter's two assistants, and remarked that the Company were to be congratulated on having such an able staff.

A vote of thanks to the staff was afterwards passed, which was acknowledged by the Secretary, and the proceedings then terminated

TUNBRIDGE WELLS WATER SUPPLY.

Evidence of the vigilance with which the Water Committee of the Tunbridge Wells Corporation and the Borough Surveyor and Water-Works Engineer (Mr. W. H. Maxwell, Assoc.M.Inst.C.E.) look after the undertaking in their charge has lately been afforded by the visit of inspection paid by them to the springs and reservoirs at Pembury and Blackhurst, from which the town derives its supply of water. In the first place, the greatest care was exercised in the selection of these springs, which are all fed from ideal gathering-grounds far removed from any risk of pollution. But, to make assurance doubly sure, each spring-head has been made absolutely safe by means of a solid brick chamber, having a heavy iron cover, which is kept carefully locked. With regard to the artesian wells, the water lies at a depth of 300 or 400 feet from the surface, and the stratas furnishing it have been ascertained to be at least 150 feet thick. Its outcrop is some miles from the borings; so that the rainfall reaching the water-bearing beds percolates through a very considerable thickness of the Ashdown sands, which ensures an unusually high standard of purity. The first spring visited on the occasion of the recent inspection was the Collins spring, on Somerford Farm, Matfield. At the present time, it is yielding 42,000

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gallons a day, which is much below its capacity. The Loudwell spring was producing 33,000 gallons per day, and two others 16,000 and about 11,000 gallons respectively, to say nothing of two additional springs. The water is conveyed by gravitation to the reservoir at Pembury, which is seven or eight acres in extent, and is capable of holding about 42 million gallons. At the time of the visit it contained some 30 million gallons, and it was estimated that, should there not be any abnormal demand for water for street cleansing and flushing purposes, it would be filled in about a month. This being so, there will be ample storage for all purposes for the summer and autumn months. There are now several sand filter-beds in working order. The water is pumped from the artesian well by means of compressed air generated by a pair of compound condensing engines with double-stage air compressors, which have been erected in an engine-house some distance from the wells. After having been suitably cooled, the air is transmitted through an air-main, and conveyed to the bottom of the wells, where it is discharged in such a manner as to effectively raise a large and continuous stream of beautifully clear water to the surface. The water area of the Corporation is a large one, and extends to a number of districts beyond the borough boundaries, and, in order to amply provide for all possible demands that may be occasioned in the future by the growth of the town, the Corporation are taking additional springs into their supply, and sinking more deep wells, some a considerable distance away from those already existing. The whole of the works for the collection, storage, and distribution of water are in a high state of efficiency. They have entailed an outlay altogether of £212,000; but the recent inspection furnished ample evidence that the money had been judiciously spent.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Since I wrote last week upon the events which have been drawing attention to the affairs of the Dundee gas undertaking, the situation has deepened into a gloom which I would fain have hoped would have been avoided. The subdued spirit in which the Gas Committee received the opinions and recommendations of Mr. Foulis made it possible to hope that they would see a way out of their difficulties without resorting to the extreme measure of bringing about a separation between them and their Manager. But apparently the spirit was only a subdued, not an altered, one; and Mr. M'Crae has felt impelled to the course of himself making the severance. His resignation (as will be seen from the report of the meeting of the Corporation, given on page 1794), was based upon a reference to a conversation which he had with the present Lord Provost, two ex-Provosts, and the Treasurer, one of them (ex-Provost Ballingall) being Convener of the Gas Committee. We do not know what took place at that meeting; but evidently it satisfied Mr. M'Crae that there were powers against him which he could not cope with, and convinced him that his best course was to retire. It is not stated in the letter of resignation, but Lord Provost Hunter interpreted it as an immediate step; and the terms of the letter make the interpretation quite a feasible one. The promptitude of the Lord Provost's ruling points to the resignation having been a matter of arrangement at the conversation referred to—that is, in effect, that Mr. M'Crae's supersession was determined upon. It is much to be regretted that the long and honourable connection of the M'Crae family with the Dundee gas supply should come to such an end. A gas manager to be successful now must strain every fibre of his constitution to get the utmost out of all the materials he handles. More than that, he must work under favourable financial conditions. These are what do not exist in Dundee, because the undertaking is admittedly in a most disappointing financial position; and this leads to the reflection that the Corporation were the original transgressors in the matters which have led to the present unfortunate state of affairs. The seeds of the Upas tree under whose shade Mr. M'Crae has fallen were sown in the distant past.

The Gas Committee met yesterday to consider as to the filling up of the vacancy. It was suggested that they should advertise, and offer a salary of £600. On the other hand, it was considered that to fix the salary might affect the applications they would receive. The suggestion was made that Mr. Donald, the Assistant-Manager, who is acting as interim Manager, should receive every encouragement; but the feeling seems to have been that it is not only a manager to conduct the works which they require, but a man of outstanding ability, who will be able to extricate them from their difficulties. It was consequently resolved to advertise the vacancy, leaving the amount of salary to be fixed afterwards. The gas undertaking in Dundee is the third largest in Scotland; the output being only exceeded in Glasgow and Edinburgh. The annual make of gas is over 650 million cubic feet. The Corporation should, therefore, be able to command the services of a good man.

Probably the leading influence in the movement which has culminated in Mr. M'Crae's retirement has been the persistent agitation on the subject by the "Dundee Courier" newspaper, in whose columns there have been frequently recurring outbursts of denunciation of the conduct of the affairs at the gas-works, in the form of letters signed "More Light." Yesterday there was another letter from the same writer, in which he claims to have been the first to point out errors. I do not conceal that I regarded the letters as aimed at the Manager; and therefore it is with some little curiosity that I read his latest letter, two passages in which I feel that I ought to give, in justice to him. He says, referring to Mr. M'Crae's resignation: "I am asking myself whether anything I have written or done, or whether your policy, aimed at that as a finale. It was never in my mind, and it is not now my opinion, that a change of managership will save the gas-works from wreck." Again, he says: "The Manager only went, and was guided, by use and wont; and now that he has gone by the board, the Council must sit up and do something to justify their *locum tenens*." The attitude of the writer is now very nearly what mine has been all along; but I think this is the first time he has disclosed himself in this light.

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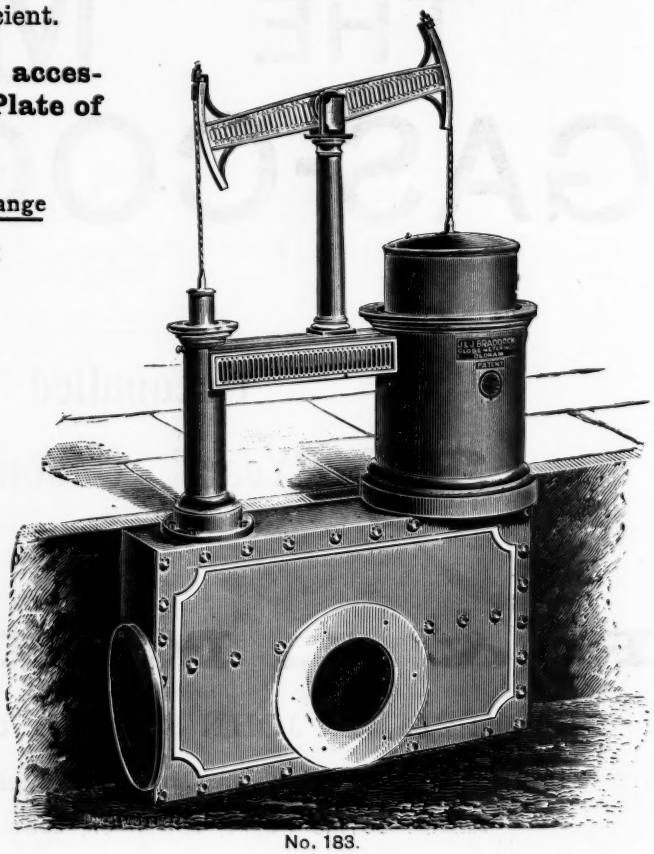

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I turn now to another instance in which an implication was cast upon one branch of the management of a corporation gas-works, but with, so far, a different result. I refer to the complaints about increased gas bills in Perth. The important points of the report of Mr Thomas Newbigging upon the subject will be found upon p. 1793. It is a complete refutation of the view that there was anything whatever wrong in the administration of the gas undertaking, and as complete a vindication of the management. Mr. Newbigging was brought to Perth to try to discover the truth, and he has discovered it. He was brought there in no friendly spirit to the management; but he acted impartially, and the result of his investigations is to bring out that the management has been of a most superior order. The Gas Committee of Perth could easily have unravelled the subject, if they had applied themselves to it, with the aid of Mr. W. B. M'Lusky, their own Engineer. It was because they distrusted him that they called in Mr. Newbigging as expert. Mr. M'Lusky can have no reason at all to regret what has been done, for he has got a certificate as to his ability and efficiency such as he could not have obtained in any other way. But surely those who have been responsible for the outlay—necessarily large—in reaching this result should, if they are in public life, retire from it, as confessedly incompetent; and whether they are in public life or not, they should now admit their mistake, and, what is more, pay for it. They ought to bear the cost of the inquiry. I have little expectation that any of the courses I recommend will be adopted, because the discontented sections have supporters in the local Press, and at all events one of these is not convinced by Mr. Newbigging's report. In a leading article this one speaks of the report as "neither happy in tone nor strong in argument," and refers to another part of it as "many reasons and explanations which have little or no bearing on the case, and, taken all in all, are little short of an insult to the common intelligence of Council and citizens alike." This is championing a cause; but it can scarcely be called reasoning. Very different is the tone of another local print, the Editor of which says he ventured to forecast some time ago that the alleged alarming increases would be found more imaginary than real. He goes on to trace the origin of the agitation to a town councillor, who found that his gas bill was somewhat larger than it was for the corresponding quarter of the previous year. This is knowledge which I do not possess; but I dare say it is correct, and, if so, it shows the source of complaint to have been inside the Corporation itself—a state of matters which cannot be regarded as creditable to the intelligence of the originator. It is reported that, although the accounts of the Perth Corporation gas undertaking are not quite made up for the past year, they will show a surplus of about £1500.

There is not in the whole of Scotland a place where it is more difficult for the gas manager to keep up a sufficient supply of gas than Falkirk. The works there should have been removed to a fresh site before now; but the delays have been many, and the construction of the new works has not been begun. The only recourse the Corporation have is to fall back upon the Manager (Mr. J. Kincaid). This they have not scrupled to do; and they have never been disappointed. The process has just been repeated. This week Mr. Kincaid has reported, at the request of the Gas Committee, upon the question of making temporary arrangements for meeting the increased consumption of gas during the winter months. He points out that the 25 per cent. increase during the past three years has been met solely by increased efficiency of the existing plant. The quantity of gas manufactured during the year ending May 15, 1902, was 130,774,200 cubic feet—an increase of 6·02 per cent. over the preceding year. The increase in December was only 2·56 per cent. This demonstrated that during the days of maximum consumption, when gas is most required, the output must be curtailed. The demand would take 5-10ths more pressure; and the consumption would be increased by 10 per cent. He assumes that the new works will not be ready for gas making before the autumn of 1904. Apart from the inadvisability of spending (say) £750 in erecting a bench of eighteen retorts for such a short term, the further curtailing of coal handling and storing space would place the manufacture of gas in greater jeopardy. But with slight alterations to the retort-house, the present conditions could be improved. A bench containing twelve retorts had not been used for two years. One reason for this was that the space for charging was limited, and the heat was very great, especially as the ventilation was defective. Mr. Kincaid showed how the ventilation could be improved by the opening of a door through the gable wall; and several other small alterations, which would allow the bench to be brought into use. This would give them an addition to the daily output of 56,000 cubic feet—fully 8 per cent. It had been suggested that, by using a better class of coal in winter, the present difficulty might be overcome; but the increased yield from the best cannel over the class contracted for would only amount to 30,000 cubic feet, yielding a daily revenue of £5, at an additional cost of £22. The Council adopted Mr. Kincaid's ingenious suggestion. He does not seem to be daunted by the thought of having to fight with inadequate works for another two winters.

The Town Council of Aberdeen have done a thing this week which savours of the strange. For months past they have had the western half of Union Street—their finest thoroughfare—lighted by the Kitson oil light. At first, the Kitson Company provided the light as an experiment; but latterly the Corporation have been paying for it. It was, of course, part of the agreement with the Corporation that if they were satisfied with the light, they were to pay for the lamps and standards. At the close of the experimental period, the Watching and Lighting Committee, out of regard for uniformity in the lighting, and considering that electricity is the only light which is fit for a gentlemanly district of the city, resolved to reject the oil light. Thereupon, it will be remembered, the Kitson Company wrote vigorous animadversions upon the treatment they had received, and the statements which had been made as to the cost of their light. It was, in consequence, resolved by the Corporation to give the Company's lamps another trial. This has been done; and his week the Committee have again come forward with a recommendation that the light be abandoned. In the Council there was a long discussion upon the subject.

JOSEPH AIRD
GREAT-BRIDGE,
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The supporters of the light asserted that the street had never been better illuminated than it had been by the oil-lamps, and that the cost was half what it would be by electric arcs. The opponents of the oil light had nothing to say against it; but they thought that the lamp standards were not what they should be. Among the opponents was Lord Provost Fleming, who stated his opinion that Union Street was one of the finest in the country; that it would be a pity to spoil its æsthetic nature and architectural beauty by the insertion of eighteen metal lamp-posts, even if they cost a pound or two less; and that the light was impracticable, unworkable, and a hopelessly out-of-date system for the lighting of a fine city like Aberdeen. The Council, by 19 votes to 14, resolved to throw out the light. It certainly does look strange that a Corporation should, after agreeing to allow an inventor to show what he could do, and finding that his system was, on its merits, quite as good as another, and as to cost only one-half, resolve to have nothing more to do with it.

A special meeting of the shareholders of the Anstruther and Cellardyke Gas Company was held on Tuesday, for the purpose of converting the undertaking into a limited liability company. It was agreed that this be done, and that the capital of the Company be £5000, in shares of £1 each. In exchange for each share held in the old Company, shareholders are to receive two fully paid-up shares in the new concern. The consumption of gas has more than doubled during the last ten years; and the reconstruction of the Company has been effected for the purpose of increasing the capital so as to allow of the works being extended.

The shareholders of the Cambuslang Gas Company held their seventeenth annual meeting on Thursday. A net balance of £2326 was reported. It was resolved to pay a dividend at the rate of 8 per cent., absorbing £1440, to place £650 to depreciation account, and to carry forward £236. It was also decided to increase the capital of the Company from £18,000 to £27,000, by the creation of 9000 shares of £1 each. The price of gas was reduced from 3s. 9d. to 3s. 4 d.

The Pitlochry Gas Company have paid a dividend of 4 per cent., and continued the price of gas at 7s. 6d. per 1000 cubic feet.

The Bridge of Earn Gas Company have paid a dividend of 3 per cent. The shareholders at their annual meeting were informed that the pipes for the supply of gas from the Perth Gas-Works would be laid, and all the arrangements made for the new supply before the end of October.

The Rhymney Arbitration Award.—It may be remembered that early last year we reported the proceedings in the arbitration to determine the sum to be paid to the Rhymney Iron and Coal Company, Limited, by the Rhymney and Aber Valleys Gas and Water Company for their water-works. The Umpire (Mr. Charles Hawksley) awarded £11,197; but as, it appears, the Iron Company have not been able to produce their title to the works, this amount has been paid into Court by the Gas and Water Company, who have executed a deed poll showing their right to take possession.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 21.

Sulphate of Ammonia.

The market has continued to droop; and the depression has been accentuated by second-hand parcels which have been put upon the market. Prices have consequently been irregular; but the nominal quotations at the close are £12 7s. 6d. per ton f.o.b. Hull, and £12 10s. per ton f.o.b. Leith and Liverpool. Consumers have been chiefly concerned with the autumn months at below prompt prices, so that the spot market has been left to those who have had June deliveries to cover, and parcels offered have only found a sale at reduced prices.

Nitrate of Soda.

This is quiet in all positions, and spot prices remain at 8s. 6d. and 8s. 9d. per cwt. for ordinary and refined qualities respectively.

LONDON, *June* 21.

Tar Products.

The markets continue very dull indeed; and there is an absence of inquiry from the Continent. Pitch, however, still maintains its value; and it is very difficult to obtain supplies sufficient to meet the demand for home consumption. A large business is reported in 90 per cent. benzol at 8d., July-December, at an outport; while for prompt delivery there is an absence of inquiry. Crude carbolic is certainly weaker. A large quantity was placed at 1s. 10d. for July-September; but consumers will not now pay more than 1s. 9d. for July-December. This is doubtless owing to the low prices ruling for crystals, as buyers will not pay more than 5½d. per lb., for 39-40's. Creosote is very dull. Consumers are not anxious to purchase, especially in the North of England, where stocks seem heavy, judging by the quantities offering. As regards toluol, solvent, and anthracene, there is nothing doing; and prices must be considered as purely nominal.

The average values during the week were: Tar, 16s. 6d. to 21s. 6d. Pitch, London, 47s. to 47s. 6d; east coast, 44s. to 44s. 6d.; west coast, 39s. to 39s. 6d. Benzol, 90 per cent., 8d.; 50-90 per cent., 7d. Toluol, 8½d. Crude naphtha, 2¾d.; solvent naphtha, 9d. to 9½d.; heavy naphtha, 9d. to 10d. Creosote, London, 1¼d.; North, 1d. Heavy oils, 1⅛d. Carbolic acid, 60 per cent., 1s. 10d. Naphthalene, 35s. to 50s.; salts, 21s. to 22s. 6d. Anthracene, "A," 1½d. to 1¾d.; "B," 1d. nominal.

Sulphate of Ammonia.

The market is decidedly easier; and there is more offering. Beckton quotations are purely nominal at £12 12s. 6d. for July-August, and £11 17s. 6d. for October-March. There is really no business doing. In Hull, business has been done at £12 7s. 6d., early shipment, in more than one instance; but there is no business to report forward. In Leith, sales have been made at £12 11s. 3d. early in the week; but the market closes at £12 10s. In Liverpool, there is certainly more offering, and £12 10s. would be accepted for prompt shipment. The market closes decidedly quiet; and in view of the Coronation festivities, there is likely to be an absence of business next week.

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COAL TRADE REPORTS.

Lancashire Coal Trade.

Generally throughout the coal trade of this district the situation remains without any very appreciable change. Requirements for house-fire consumption are perhaps beginning to slacken off to something like their normal level; but so far collieries have mostly been moving away all the pits have been raising, and there is no accumulation of stocks. The reduction of wages, though it may be used as a means of pressure by buyers for some further concessions in prices, is not at all likely to bring about any official reduction in list rates; and certainly there is no talk of lower prices with the close of the present month. At the pit, best Wigan Arley is steady at 13s. 6d. to 14s. per ton, Pemberton four-feet and seconds Arley at 12s. to 12s. 6d., and common house coal at 9s. 6d. to 10s. With regard to other descriptions of round coal, the demand for steam and forge qualities continues moderate, with pit prices maintained at about 8s. 6d. to 9s. per ton for inland sales, but rather low prices still ruling for shipment—common sorts being obtainable at 9s. 6d. to 9s. 9d., with best descriptions of steam coal quoted at 10s. to 10s. 3d., delivered at the Mersey ports. The settlement of gas coal contracts goes on steadily at about the prices reported of late—7s. 9d. to 8s. per ton at the pit being quoted for the better qualities of Arley slack suitable for gas making, 8s. 9d. to 9s. for Wigan four-feet, and 10s. to 10s. 3d. for best screened Arley gas coals. More or less general improvement is noticeable throughout the engine fuel trade. The better qualities, especially, are meeting with an increased inquiry; and this, in considerable measure, is due to the large requirements now on the market in connection with electric power stations, of which a number are coming into operation throughout the district. This additional source of consumption may very probably materially help to strengthen the position of slack in the near future. For the better qualities of Lancashire slack, prices are firm at 6s. 6d. to 7s. per ton, with washed slacks fetching up to 8s. There is still a good deal of competition in the inferior sorts of slack, owing to the pressure of surplus supplies from outside districts, but, if anything, prices are rather steadier than they have been, and it is only very inferior descriptions of Lancashire slack that can be bought under 4s. 9d. to 5s. per ton at the pit. For coke, there is a continued good inquiry, with prices strong, and a hardening tendency on contracts for forward delivery. At the ovens, the best basis remains, however, without quoted change.

Northern Coal Trade.

The demand for coals has been better sustained in the past few days, because there is a desire to accumulate stock against the holidays, which will increase the consumption of some kinds of coal, and will interfere with the production generally. Best Northumbrian steams are fairly firm at from 11s. 3d. to 11s. 6d. per ton f.o.b. Second-class steams are very dull, with a moderate demand, and with prices varying from 9s. 3d. to 10s. per ton. Steam smalls are also dull at about 5s. per ton. In the gas coal trade, best Durham sorts are steady, without much pressure in the demand. Gas coals vary in price from 8s. 3d. to 9s. 3d. per ton f.o.b., according to quality. There are several contracts under negotiation, but not for very heavy quantities; and it is probable that they will ultimately be arranged at rates that are near the mean of the two prices just given. Best Durham coke is steady at from 17s. to 17s. 6d. per ton f.o.b. Blast-furnace coke is firm at 15s. 3d. on Teesside. Gas coke varies with different companies; but the current quotation on the Newcastle Exchange may be put as on the basis of about 10s. per ton f.o.b. The production is now locally very limited.

Scotch Coal Trade.

There is a slight improvement in the demand for shipment, but otherwise the market is unchanged. A combination among the lesser collieries is being negotiated, the effect of which may be to enhance prices, although even that is doubtful; the principal result, it is believed, if it is ever realized, being a saving in working costs. The home trade cannot be said to have experienced either improvement or otherwise on account of the settlement in South Africa. The prices quoted are: Main 8s. 3d. to 8s. 6d. per ton f.o.b. Glasgow, ell 9s. 3d. to 10s. 3d., and splint 9s. 3d. to 9s. 6d. The shipments for the week amounted to 220,426 tons—an increase of 24,127 tons upon the previous week, and of 3823 tons upon the corresponding week of last year. For the year to date, the total shipments have been 4,477,132 tons—an increase of 310,499 tons over the same period of last year.

The Gas Lighting and Apparatus Manufacturing Company of Paris.—According to particulars furnished at the recent general meeting, this Company own 23 gas-works and rent 13 others. The quantity of gas sold in 1901 amounted to 4,085,889 cubic metres (about 144,232,000 cubic feet), which was 248,862 cubic metres (8,784,830 cubic feet) more than in the preceding year. Notwithstanding this, however, the revenue was less, owing to the high price of coal and the falling off in the returns from coke and tar. Even the sale of gas-fittings to private persons decreased greatly, no doubt on account of the general stagnation of business. It was the same in the case of appliances out on hire. In 1900 these installations represented 253,037 frs., but only 176,900 frs. last year. The net receipts were 453,011 frs. in 1900, and 372,784 frs. in 1901. Although the past year was particularly unfavourable, the Directors thought this was not a reason for losing confidence in the industry. Coals were cheaper, so that the results for the present year would, no doubt, be better. The dispute in regard to the price of gas in Paris caused a considerable decrease in the demand for additional installations of plant; occupiers who had not adopted gas preferring to wait until it was 20 c. per cubic metre before doing so. The profits resulting from the Company's factories exceeded those for 1900 by 21,243 frs. During 1901 an agency was established in Turin; bringing the number of branches up to six—at Lille, Nantes, Toulouse, Rouen, Madrid, and Turin.

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COLCHESTER	300,000	CRYSTAL PALACE DISTRICT	2,000,000
BIRKENHEAD.	2,250,000	DULUTH, MINN.	300,000
SWINDON (New Swindon Gas Co.)	120,000	CATERHAM	150,000
SALTLEY, BIRMINGHAM (Second Contract)	2,000,000	LEICESTER	2,000,000
WINDSOR ST., BIRMINGHAM (Second Contract)	2,000,000	ENSCHEDE (HOLLAND)	150,000
HALIFAX	1,000,000	BUENOS AYRES (RIVER PLATE CO.)	700,000
TORONTO	250,000	BURNLEY	1,500,000
OTTAWA.	250,000	KINGSTON-ON-THAMES	1,750,000
LINDSAY (Remodelled)	125,000	ACCRINGTON.	500,000
MONTREAL	500,000	TONBRIDGE	300,000
TORONTO (Second Contract; Remodelled)	2,000,000	STRETFORD	500,000
BELLEVILLE.	250,000	OLDBURY	300,000
OTTAWA (Second Contract)	250,000	TODMORDEN	500,000
BRANTFORD (Remodelled)	200,000	SALTLEY, BIRMINGHAM (Third Contract)	2,000,000
ST. CATHERINES (Remodelled)	250,000	YORK (Second Contract)	750,000
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Further Extension of Incandescent Gas Lighting in Paris.—The Municipality of Paris have lately placed with the Société Anonyme des Anciens Etablissements Lacarriere an order for 5200 incandescent burners, to be substituted for the old flat-flame burners still in use for the public lighting.

Coventry Water Supply.—The annual report of the Coventry Corporation Water Department shows a balance of revenue over working expenses of £3181, and, after deducting capital charges, a net profit of £1202. At the close of the financial year, there remained an unappropriated cash balance of £3551; and it has been agreed that £3000 of this shall be devoted to the relief of the rates.

New Coal Area in Staffordshire.—The mining resources of Staffordshire were believed to be approaching exhaustion; but it is reported from Dudley that in the South Staffordshire colliery district the work of exploration, which has been carried on for nearly four years, has been attended with success. Messrs. Mansell and Mason, of the Pennant Hill Colliery, have bored through the boundary fault, and tapped a virgin seam of thick coal, of which, it is believed, 15 acres lie within their estate, and which is thought to extend a considerable distance beyond.

Cockermouth Gas Supply.—The balance-sheet of the Cockermouth gas undertaking, for the year ending March 31, which has just been issued, shows that, owing to the high price paid for coal and the low returns from residuals, the expenditure exceeded the income by £33. The gross profits amounted to £898; but as the sum required for interest on loans was £536, and the amount of principal repaid was £395, the year's operations resulted in the working balance being reduced from £1458 to £1425. In moving the adoption of the report, Mr. W. Stephenson asked the Council to bear in mind that the selling price of gas was 3s. 3d. per 1000 cubic feet before the cost of coal went up 50 per cent., and that the charge had not been interfered with, in spite of the continued dearness of coal. The report was adopted.

The Assessment of the Hampton Court Gas-Works.—At a recent meeting of the Assessment Committee of the Kingston Union, they had before them their valuer's report on the appeal of the Hampton Court Gas Company against the assessment of their property in Hampton Wick, Hampton, Teddington, and the Moleseys. Mr. Cooke reported that he had made an amended valuation, based on the Company's 1901 accounts, and recommended the Committee to agree to a net total assessment of £4457—a decrease of some £1500 on the previous assessment, and an advance of £500 on the figures of some three years ago. The decrease was due to the high price paid for coal, and the comparatively low price received for residuals; besides which the Directors had increased their salaries. It was quite likely, added Mr. Cooke, that the concern would right itself. Replying to questions by Mr. Andrews, who said that the Company's assessment in East Molesey was below the original, Mr. Cooke explained that they had added a new gasholder to their works, the parish in which they were situated (Hampton Wick) getting the benefit of it. The Committee confirmed the valuation, which Mr. Cooke said had been agreed to by the Company.

National Dry Gas-Meters, Limited.—A Company has been registered under this title, with a capital of £5000, in £1 shares, to acquire an invention (No. 10,770 of 1901) for improvements in dry gas-meters and the patent granted in respect thereof to Mr. A. Schofield, to manufacture and vend the same, and to adopt an agreement entered into with Mr. Schofield and others. There will be no initial public issue.

The Corporation of Kilmarnock have reduced the price of gas from 3s. 1½d. to 2s. 11d. per 1000 cubic feet.

The Indian camp at Hampton Court is lighted at night by twelve Kitson lamps, each of 1000-candle power.

The Coalville Urban District Council have placed the order with Messrs. R. Dempster and Sons, Limited, of Elland, for two regenerator settings of six retorts each.

The Special Water Committee of the Penrith Urban Council have completed an agreement with Mr. Baldwin Latham, of Westminster, to take the position of Water Engineer in connection with their new scheme.

The tender for a new gasholder for the Darlington Corporation has been let to Messrs. Newton, Chambers, and Co., of Sheffield, and the tender of Messrs. Smith Bros., Limited, of Burnley, for the tank has been accepted.

An exhibition of the gas appliances of Messrs. Fletcher, Russell, & Co., Limited, and the Richmond Gas Stove and Meter Company, Limited, was held at Broughty Ferry last week. Mrs. A. R. Stevenson was the lecturer.

The Gas Committee of the Bradford Corporation have accepted tenders for between 70,000 and 80,000 tons of coal, an amount representing about half the estimated consumption during the next twelve months. The contracts have been placed at a reduction of from 1s. to 1s. 6d. per ton as compared with last year.

In the "JOURNAL" for the 3rd inst., it was announced that a Company had been formed, under the title of the Natural Gasfields of England, with a capital of £100,000, to adopt an agreement with the Natural Gas and Power Company, Limited, to search for natural gas. In a recent issue, the "Financier and Bullionist" reproduced a paragraph coupling Mr. Pierpont Morgan's name with this new venture. The writer said: "Considerable progress is being made in operations for tapping a large subterranean lake. Three shafts have already been sunk, a fourth is being made, and four more are to follow. A depth of 350 feet has been reached, with encouraging results; but it will be necessary to go a further 200 feet before the lake is fully tapped. Mineral rights over 100,000 acres have been acquired." Our contemporary the "Petroleum Review" awaits the result of this work with exceeding interest, as, if the lake is found, it will not be the first time that Mr. Morgan has struck "ile."

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GASHOLDERS, 15 ft. to 50 ft. diameter.
Iron or Steel TANKS for ditto.
SCRUBBERS AND WASHERS, by Holmes, Clapham, &c.
CONDENSERS—Pipe, Annular, and Patent Condensers.
PURIFIERS, from 4 ft. to 20 ft. square.
RETORT-FITTINGS, METERS, GOVERNORS, VALVES, &c.
Every Description of NEW PLANT supplied.

FIRTH BLAKELEY AND Co., Gas Engineers, DEWSBURY.

TENDERS FOR GAS COAL.

THE Magistracy of Copenhagen are prepared to receive TENDERS for the supply and delivery of 60,000 to 70,000 Tons of best GAS COAL from the end of December, 1902, until the end of February, 1903.

The Magistracy reserve the right to divide the Contracts between two or more Contractors.

Further Information and Conditions for the delivery may be obtained on application to Kobenhavns Belysningsvœsen, Vestre Boulevard, Kobenhavn B.

The Tenders, sealed and marked "Tilbud paa Kul," to be sent to Magistratens, 4 Afdeling, Det nye Raadhus, Kobenhavn B, before the 7th of July, 1902, Twelve o'clock, at which time the Tenders will be opened in the presence of the parties tendering who are in attendance.

THE MAGISTRACY OF COPENHAGEN.

June 17, 1902.

CORPORATION OF LOUGHBOROUGH.

TENDERS FOR COAL.

THE Gas Committee are prepared to receive TENDERS for the supply of the whole or part of 6000 Tons of best screened GAS COAL and 2000 Tons WASHED NUTS, to be delivered at Loughborough Station at such times and in such quantities as may be required during the Year from the 1st of July, 1902, to the 30th of June, 1903.

Sealed Tenders, to be addressed to the undersigned and marked "Tender for Coal," and to be delivered not later than Tuesday, the 1st of July, 1902.

The Committee do not bind themselves to accept the lowest or any Tender, and reserve to themselves the power to accept a portion of a Tender.

By order of the Gas Committee,
EDWARD ONIONS,
Engineer and Manager.

June 16, 1902.

CORPORATION OF LOUGHBOROUGH.

TENDERS FOR TAR AND AMMONIACAL LIQUOR.

THE Gas Committee invite Tenders for their surplus TAR and AMMONIACAL LIQUOR for the ensuing Twelve Months ending the 30th of June, 19 3.

Estimated amount of Tar, 700 tons; Liquor 1000 tons.

The Contractor to state price for Liquor at 5° Twaddel, and per ton extra for every ½° above 5°.

The Corporation to deliver both Tar and Liquor into the Contractors' Boats at the Derby Road Wharf, Loughborough.

The Committee do not bind themselves to accept the highest or any Tender.

Sealed Tenders to be signed and endorsed "Tender for Tar," and delivered to the undersigned by Tuesday, the 1st of July, 1902.

By order of the Gas Committee,
EDWARD ONIONS,
Engineer and Manager.

June 16, 1902.

ELLAND-CUM-GREETLAND GAS COMPANY.

ISSUE OF £22,500 ADDITIONAL ORDINARY STOCK.

THE Elland-cum-Greetland Gas Company, pursuant to the Powers contained in the Elland Gas Act, 1901, offer for SALE BY TENDER, in Lots of £100 Stock each Lot (except the last lot, which will include the balance of the Stock offered),

£22,500 ADDITIONAL ORDINARY STOCK,

or such part thereof as will, with the net premiums realized on the Sale, produce the Capital Sum of £22,500.

This Additional Ordinary Stock will rank after the Preference Stock of the Company, and will be entitled out of the profits of the Company to a Dividend not exceeding £5 per cent. per annum. The last day for the reception of Tenders is the 17th day of July, 1902.

Form of Particulars of Sale and Conditions of Sale can be obtained from Mr. Robert Porter, Engineer and Secretary, the Gas-Works, Elland, Yorkshire, or from us the undersigned Solicitors to the Company.

LONGBOTHAM AND SONS.

4, Carlton Street, Halifax,
June 17, 1902.

TENDERS FOR COAL.

THE Directors of the Isle of Thanet Gas Company are open to receive TENDERS for good GAS COAL for One, Two, or Three Years.

Forms of Tender containing Particulars and Conditions of the Contract may be had on application to the undersigned or of the Engineer, Mr. J. Dougall.

Sealed Tenders, endorsed "Coal," to be addressed to the Chairman, and sent in not later than July 3 next.

By order,
THOS. C. FULLER,
Secretary.

The Offices, The Dane,
Margate, June 13, 1902.

COALVILLE URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the supply of about 1750 Tons of GAS COAL and WASHED NUTS for delivery at Coalville Midland Station during the Year ending the 30th of June, 1903.

Sealed Tenders, endorsed "Tenders for Coal," and addressed to the Chairman of the Gas Committee, Council Chambers, Coalville, near Leicester, to be sent in not later than July 10, 1902.

The Committee do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right to divide the quantity.

J. W. EAGLES,
Manager.

Gas-Works, Whitwick,
June 19, 1902.

URBAN DISTRICT OF SKIPTON.

(GAS DEPARTMENT.)

TAR.

THE Council invite Tenders for the purchase and removal of surplus TAR produced at the Skipton Gas-Works between July 1, 1902, and June 30, 1903. Probable quantity 400 Tons.

The Council reserve the right to let the Contract in one or more lots.

Further Particulars may be obtained from Mr. J. H. Woodward, the Gas-Works, Skipton, to whom Tenders, endorsed "Tar," are to be sent before Wednesday, July 9, 1902.

RICHARD WILSON,
Clerk to the Council.

Skipton, June 21, 1902.

CORPORATION OF LEICESTER.

GASHOLDER.

CONTRACT No 72.

THE Gas and Electric Lighting Committee of the above Corporation are prepared to receive TENDERS for the supply and erection of a THREE-LIFT TELESCOPIC GASHOLDER, 197 ft. 8 in. diameter, at their Aylestone Road Works.

Tenders, addressed to Mr. Councillor Edwards, Chairman, and endorsed "Tender for Gasholder," to be delivered at these Offices not later than Eleven o'clock a.m., on Monday, July 14, 1902.

The Committee do not bind themselves to accept the lowest or any Tender.

ALFRED COLSON, M.Inst.C.E., M.Inst E.E.
Engineer and Manager.

Offices: Millstone Lane,
Leicester, June 21, 1902.

HORSHAM GAS COMPANY, LIMITED.

TENDERS FOR GAS COALS.

THE Directors of the Horsham Gas Company, Limited, invite TENDERS for the supply of about 3000 Tons (more or less) of the best screened Yorkshire Silkstone, such as Barrow or Strafford, &c., or Wigan and Durham GAS COAL (Durham in small quantities preferred), to be delivered free at Horsham Station during the Twelve Months commencing Aug. 1, 1902, and terminating July 31, 1903.

Tenders to be addressed and delivered to the undersigned on or before the 7th of July, 1902.

The Directors do not bind themselves to accept the lowest or any Tender.

Further Particulars and form may be obtained on application to

E. D. SAFEY,
Manager and Secretary.

Gas Office, Horsham,
June 19, 1902.

BOROUGH OF KENDAL.

(GAS, WATER, AND ELECTRICITY DEPARTMENTS.)

TENDERS FOR COAL.

THE Gas, Water, and Electricity Committee of the Borough of Kendal are prepared to receive TENDERS for the supply of about:—

500 Tons of best screened GAS COAL.
500 Tons of best CANNEL COAL.
100 Tons of NUT COAL for Steam Purposes.

for a period of Twelve Months commencing Aug. 1, 1902.

Tenders to state price delivered at Kendal Station, or in boats alongside the Corporation Wharf on the Lancaster and Kendal Canal, in such quantities as may be from time to time required.

Further Particulars and Form of Tender may be obtained of the undersigned.

Sealed Tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, to be addressed to the Chairman of the Gas, Water, and Electricity Committee, Gas-Works, Kendal, on or before Saturday, July 12, 1902.

The Corporation reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any Tender.

By order,
T. N. RITSON, Assoc.M.Inst.C.E.
Engineer and Manager.

Gas-Works, Kendal,
June 24, 1902,

BARNOLDSWICK URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

TENDERS are invited for the supply of 2600 Tons of GAS COAL, to be delivered during the Year ending June 30, 1903.

Particulars and Form of Tender may be obtained from the undersigned.

D. E. GARLICK,
Manager.

ALTRINCHAM GAS COMPANY.

TENDERS FOR TAR.

THE Directors of the above Company invite TENDERS for the surplus TAR produced at their Works between the 1st of July next and the 30th of June, 1903.

The Offers to be both at a fixed price per ton, and on the sliding-scale.

Delivery into Contractors' or Gas Company's Tank-Waggons at Altrincham Station.

Sealed Tenders, addressed to the Chairman and endorsed "Tender for Tar," to be delivered not later than Tuesday, the 8th of July.

The Directors do not bind themselves to accept the highest or any Tender.

J. E. LAMB,
Manager.

Gas Offices, Altrincham,
June 16, 1902.

CORPORATION OF DROITWICH.

(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the supply of 1800 to 2000 Tons of Best Screened GAS COAL or NUTS during the ensuing Twelve months, ending June 30, 1903, to be delivered at Droitwich (G.W. Rly.).

Specification and Form of Tender may be obtained on application to the Manager, Mr. S. G. Askew.

The Committee reserve the right to accept Tenders for the whole or any portion of the quantity offered, and do not bind themselves to accept the lowest or any Tender.

Sealed Tenders, endorsed "Tender for Gas Coal," to be sent to the undersigned not later than the 4th of July, 1902.

S. JNO. TOMBS,
Town Clerk.

Town Hall, Droitwich,
June 13, 1902.

SHIFNAL GASLIGHT AND COKE COMPANY.

TENDERS FOR GAS COAL.

THE Managing Partners of the above Company are prepared to receive TENDERS for the supply of 1000 Tons, or less, of a good quality of GAS COAL or large NUTS, including carriage to G.W.R. Station, Shifnal, Salop, for a period of Twelve Months from, or soon after, the end of the present month.

Tenders to be accompanied by practical Working Analysis.

The Coal and Nuts to be free from Sulphur, Bats, Refuse, and Dirt, and to be weighed (21 cwt. to the Ton) upon the Company's machine.

The supply to be in such quantities weekly as may be ordered by the Clerks to the Company.

Payments will be made from time to time, so long as he contractor shall duly fulfil his contract.

The Managing Partners do not pledge themselves to accept the lowest or any Tender.

Sealed Tenders, endorsed "Tender for Gas Coal," must be delivered at our Offices, Victoria Road, Shifnal, Salop, not later than Saturday, the 28th of June inst.

By order,
FARMER AND FARMER,
Joint Clerks to the said Company.

June 10, 1902.

HORLEY DISTRICT GAS COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of the Company, so far as they relate to DEBENTURE STOCK, WILL BE CLOSED from Thursday next the 19th inst., for the Half Year ending June 30, 1902, and will be RE-OPENED on Tuesday, the 1st of July prox.

By order of the Board,
R. SEYMOUR TOBEY,
Secretary.

Offices, Station Road,
Horley, Surrey.

RUGBY GAS COMPANY.

INCORPORATED BY THE RUGBY GAS ACT, 1882.

250 SHARES OF £10 EACH

(Additional Capital), or such less number as shall be declared at the time of Sale,

TO BE SOLD BY AUCTION, BY

MR. JOHN R. TAIT, at the Royal George Hotel, in Rugby, on Friday, the 4th day of July next, at Four o'clock in the Afternoon precisely, by order of the Company (under the provisions of the Rugby Gas Act, 1882), in Lots of Five Shares each.

The above Shares are part of the authorized Additional Capital of the Company, and bear the Standard Dividend of £7 per cent., subject under the sliding-scale to increase or diminution with the price charged for Gas.

The present price of Gas admits of a Dividend on these Shares of £10 per cent. per annum.

The Dividend on the Original Capital of the Company for the past Three Years has been £13 per cent. per annum.

Particulars and Conditions of Sale may be obtained after Friday next, at the Offices of the Company, Railway Terrace, Rugby; of the AUCTIONEER, 2, Albert Street, RUGBY; of Messrs. WRATISLAW AND THOMPSON, Solicitors, RUGBY; or from the undersigned,

T. M. WRATISLAW,
Secretary to the Company.

Rugby, June 6, 1902.

ASHMORE, BENSON, PEASE, & CO., LTD., last and next week.

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THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT
[REGISTERED AS A NEWSPAPER.

VOL. LXXIX. No. 2041.] LONDON, JUNE 24, 1902. [54TH YEAR. PRICE 6d.

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& CHEMICAL COMPANY, Ltd.
PALMERSTON HOUSE, LONDON, E.C.
Telegrams: "PURIFICATION, LONDON."
Telephone: 9144 LONDON WALL.

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BRITANNIA & PATENT TUBE WORKS,
WOLVERHAMPTON,
LONDON & LIVERPOOL.
E. L. & S.
TUBES & FITTINGS.

THOMAS PIGGOTT & CO., LTD.,
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GAS PLANT.
LONDON OFFICE: 14 GREAT ST. THOMAS APOSTLE, E.C.

TORBAY - - - PAINT.
The TORBAY PAINT CO.,
26, 27, & 28, Billiter Street, London, E.C.
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Also at Brixham & Dartmouth, Devon.

TRADE MARK.
JOHN RUSSELL & CO., LTD.
Established at the Commencement of Gas Lighting.
MANUFACTURERS OF
TUBES & FITTINGS
For GAS, WATER, and STEAM.
STOCKS, TAPS, and DIES.
CHANDELIERS AND BRASS FITTINGS.
Pendants and Brackets for Prepayment Meter Supplies.
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CROSSLEY'S
"OTTO" GAS-ENGINE
Crossley's Engines and Pumps
are used in all the most recent and important Towns' Water and Sewage Installations,
LATER PATENTS. MANY NEW IMPROVEMENTS.
CROSSLEY BROS., Ltd.,
OPENSHAW, MANCHESTER.

PARKINSON AND W. & B. COWAN, LTD.,
Parkinson Branch: LONDON AND BIRMINGHAM.
See Advertisements on p. 1742 and last White Page.
Cowan Branch: LONDON, MANCHESTER, EDINBURGH, & SYDNEY, N.S.W.
See Advertisement on Third Page of Wrapper.

JAMES McKELVIE & CO.,
CANNEL & GAS COAL EXPORTERS,
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37 & 38, MARK LANE, LONDON, E.C.
GUILDHALL CHAMBERS, SANDHILL, NEWCASTLE-ON-TYNE;
51 & 53, CASTLE STREET, LIVERPOOL.
PRICES AND ANALYSIS
of all the principal
CANNEL and GAS COALS
forwarded on Application.
ESTABLISHED 1840.

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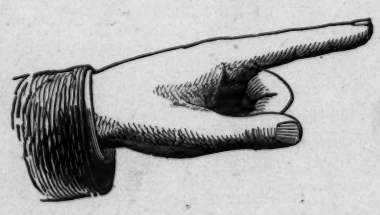
LLOYD & LLOYD, LIMITED,
NILE STREET.
BIRMINGHAM.
L & L
Tubes and Fittings.



"And for my name of GEORGE begins with G,
It follows in a thought that I am he.—*King Richard III.*

GEORGE
GLOVER'S.

ASHMORE, BENSON, PEASE, & CO., LTD., last and next week. | T. & J. DEMPSTER, LTD., ON LAST PAGE BUT ONE.

Telegrams:
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THE WHESSOE FOUNDRY COMPANY, LIMITED, DARLINGTON.
SUPPLY GAS PLANT OF EVERY DESCRIPTION FROM RETORT TO GASHOLDER, INCLUDING BENCH MOUNTINGS, CONDENSERS, EXHAUSTERS, SCRUBBERS, PURIFIERS, GASHOLDERS AND TANKS.
MR. THOS. COATES, C.E., MANAGING-DIRECTOR.
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106, Cannon St. E.C.

Established 1790.

Estimates on Application.

THE GLENBOIG UNION FIRE-CLAY Co. Ltd.

THE LARGEST MANUFACTURERS OF GAS-RETORTS IN GREAT BRITAIN.
FIRE-BRICKS, BLOCKS, &c., &c., for RETORT-SETTING.

WORKS:
Glenboig, nr. Coatbridge.
OFFICES:
48, WEST REGENT ST., GLASGOW.

— 42 —
Prize Medals & DIPLOMAS OF HONOUR.
HIGHEST AWARD *wherever exhibited.*

The SPECIAL BRICKS used in the Construction of Gas Furnaces now being introduced for Heating Retorts.

The Glenboig Bricks, Blocks, and Retorts combine, in the highest degree, the qualities of not melting, and not splitting, when subjected to the highest heats and most sudden changes of temperature, and are in consequence, found to be economical, even in districts where the local bricks can be had at half the price.

RAPID READING PHOTOMETER
FOR
WATER GAS.

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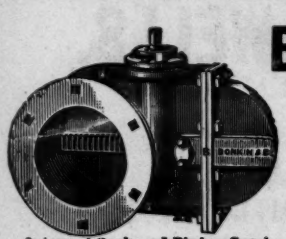
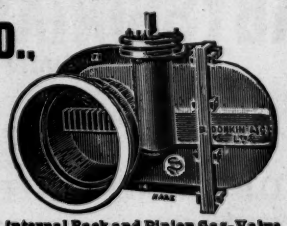
ENGINEERS, BERMONDSEY, LONDON, S.E.

Head Office: AS ABOVE. Works: BERMONDSEY & CHESTERFIELD.
ORIGINAL MAKERS OF THE
INTERNAL RACK AND PINION GAS-VALVE IN 1847.



Internal Rack and Pinion Gas-Valve (Flange.)



Internal Rack and Pinion Gas-Valve (Spigot and Socket).

Large Stocks kept. Prompt delivery.

All tested to 80-lbs. pressure. Pinions of forged Steel.

Rack and Pinion Gas-Cock

Over 100,000 now supplied.

Teeth cut out of the solid. All Valves fitted with Patent Volute Springs.

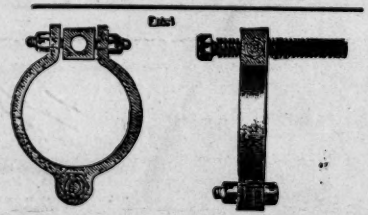
Outside Rack and Pinion Gas-Valve. Fig. 8.

Outside Screw Gas-Valve Fig. 18.

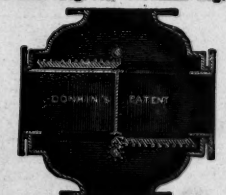
Internal Worm & Rack Valve & Column. Fig. 33.

Internal Rack and Pinion Valve and Column. Fig. 32.

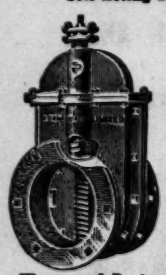
Self-Acting Bye-Pass.



HELPS' PATENT PIPE-EXTRACTOR.



Four-Way Valve for Meters, Governors, Purifiers, &c.



Worm and Rack Valve. Fig. 36.

Water-Valve, for 300-lbs. pressure.

MANCHESTER OFFICE:
Mr. Henry Thomas, 10, Mawson's Chambers, Deansgate.

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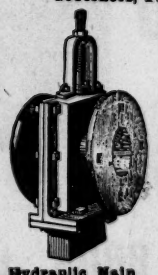

Hydraulic Main Seal Regulating Valve. Fig. 34.

Irving Patent Regulating and Flushing Valve.

C,19c.

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VOL. LXXIX. No. 2041.] LONDON, JUNE 24, 1902. [54TH YEAR. PRICE 6d.

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OXIDE PAINTS, OILS, AND GENERAL STORES, FOR GAS AND WATER WORKS.

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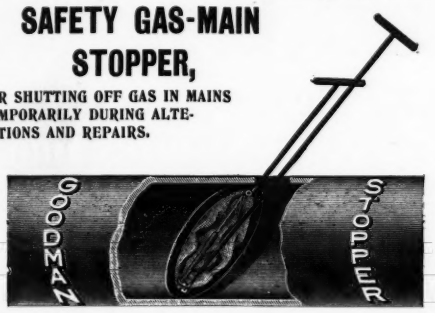
FOR SHUTTING OFF GAS IN MAINS TEMPORARILY DURING ALTERATIONS AND REPAIRS.



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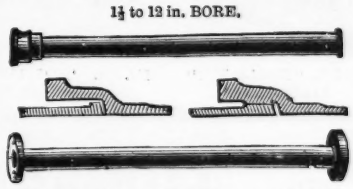
GAS AND WATER PIPES

1¼ to 12 in. BORE.



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"ABYSSINIAN" & ARTESIAN TUBE WELLS,

FOR TOWN WATER-WORKS AND OTHER SUPPLIES.

The following Town Water-Works Supplies have been obtained by this System, viz. :—Abbott's Langley, Aldershot, Alnwick, Cirencester, Hertford, Lechlade, St. Albans, Shrewsbury, Skegness, Southampton, Stony Stratford, Swansea, Wallingford, Watford, West Worthing, Wimborne, &c.

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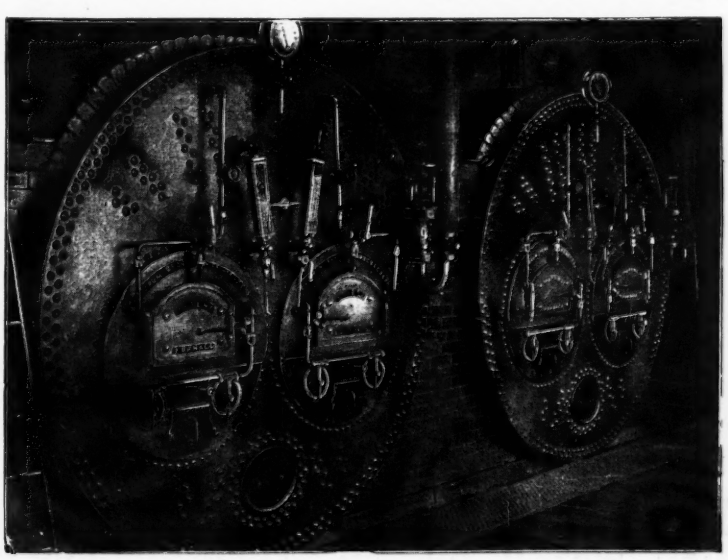
HYDRAULIC ENGINEERS, 100, BUNHILL ROW, LONDON, E.C.

THE "MELDRUM" BREEZE FURNACE.

More Steam.

Less Cost.



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SUITABLE FOR ALL KINDS OF BOILERS, AND ALL KINDS OF FUEL.

FOR FULL PARTICULARS, ETC., APPLY TO

MELDRUM BROS., LTD., Atlantic Works, MANCHESTER; & 66, VICTORIA ST., LONDON, S.W.

JOSEPH EVANS & SONS, CULWELL WORKS, WOLVERHAMPTON.

Telegrams: "Evans, Wolverhampton." London Address: Salisbury House, London Wall, London, E.C. National Telephone No. 7089

Please apply for Catalogue No. 8.

12,000 PUMPS IN STOCK AND PROGRESS.

TRADE MARK.

NO TAPPETS.

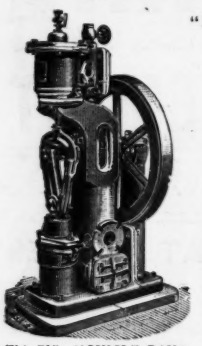

Fig. 705. "SINGLE RAM" STEAM-PUMP.

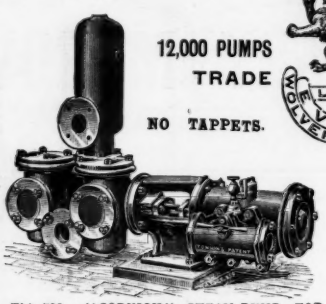

Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

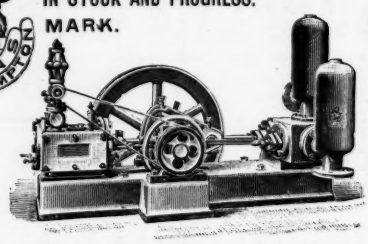

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

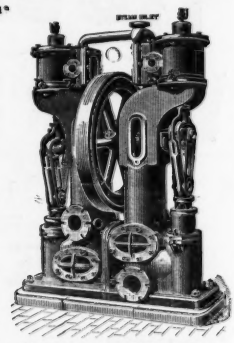

Fig. 712. "DOUBLE-RAM" STEAM-PUMP.

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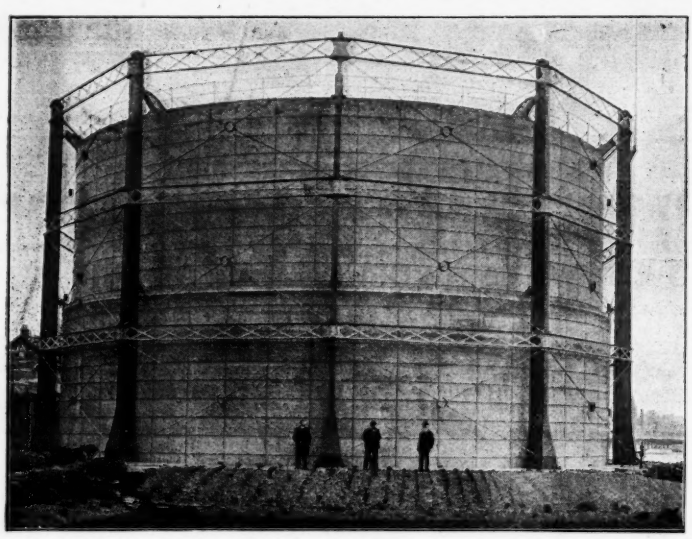

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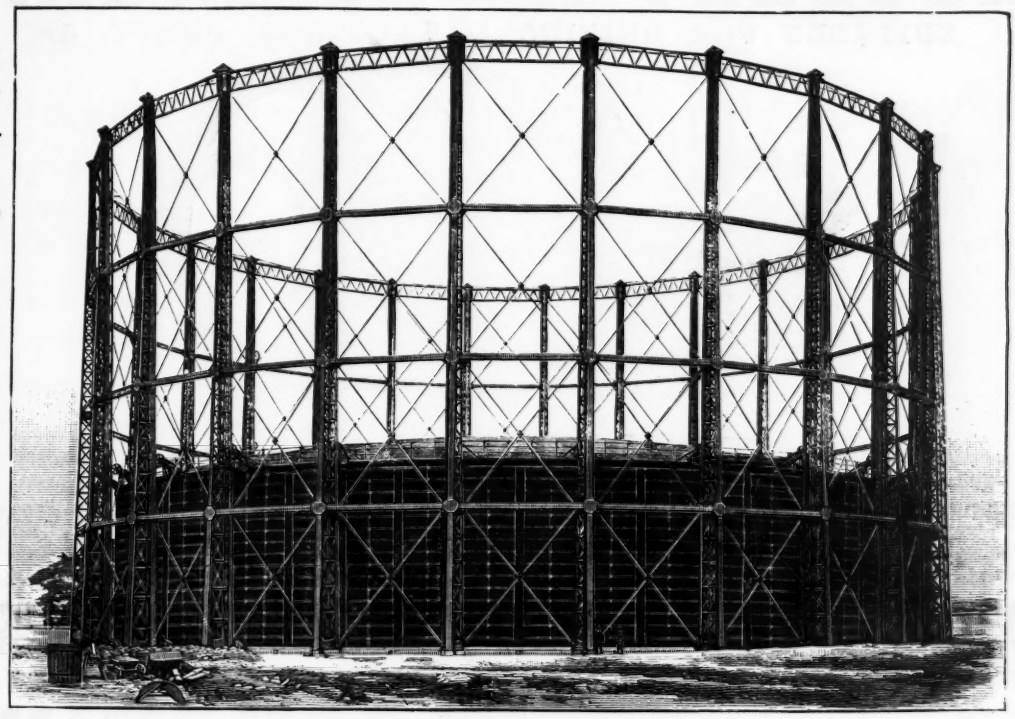

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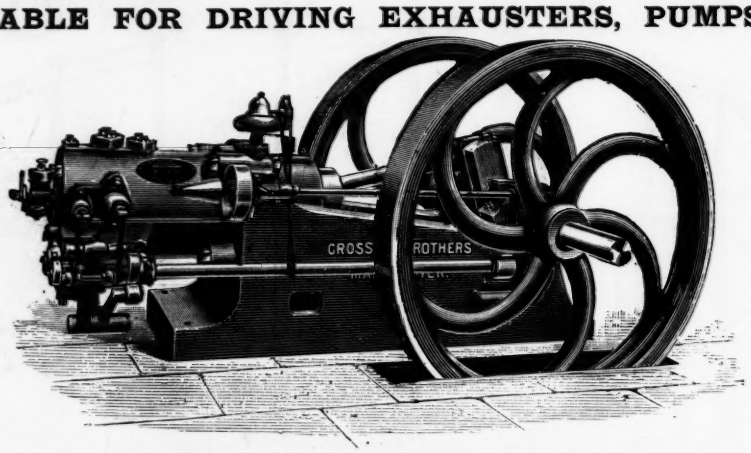

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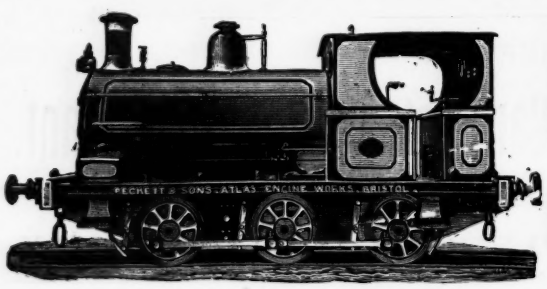

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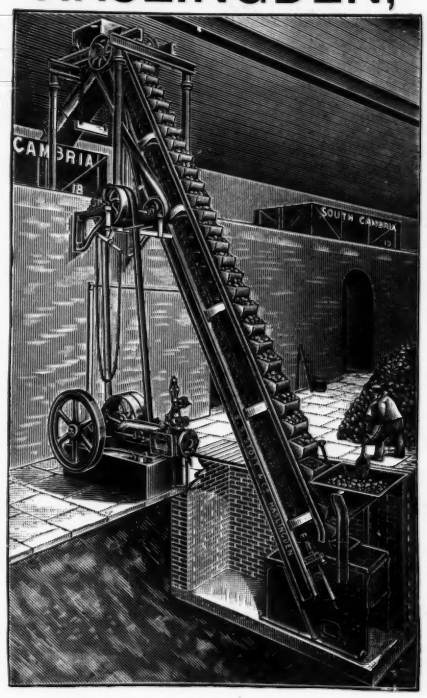

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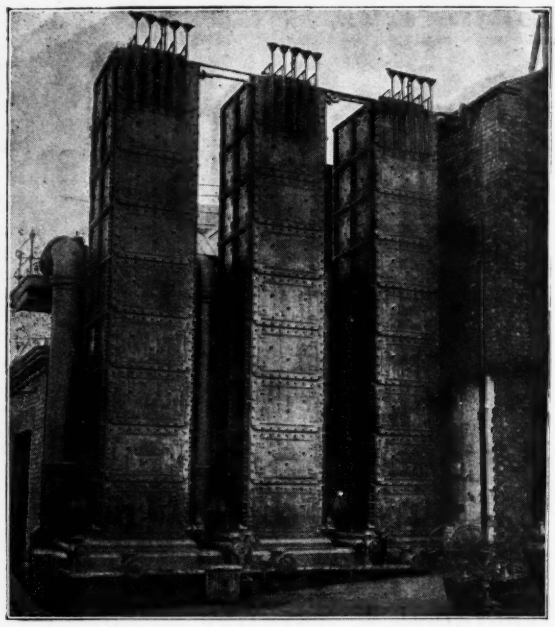

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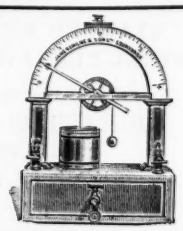

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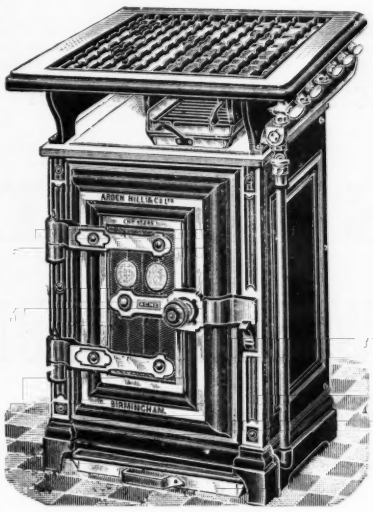

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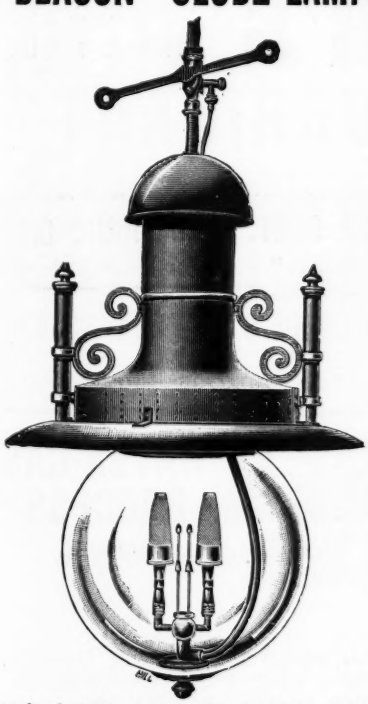

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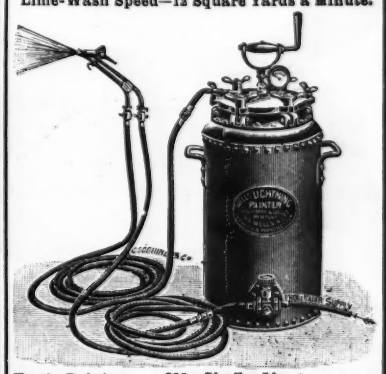

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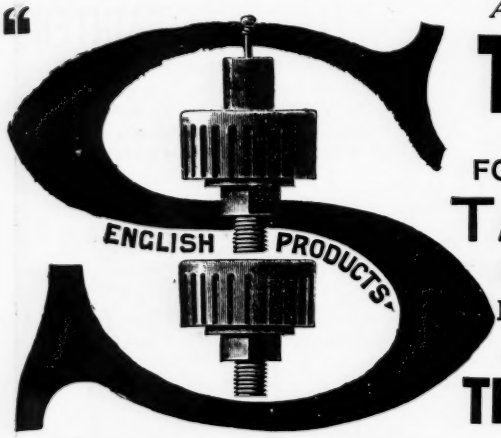

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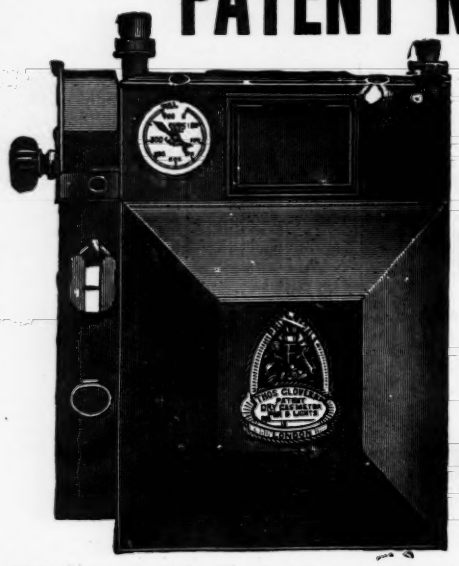

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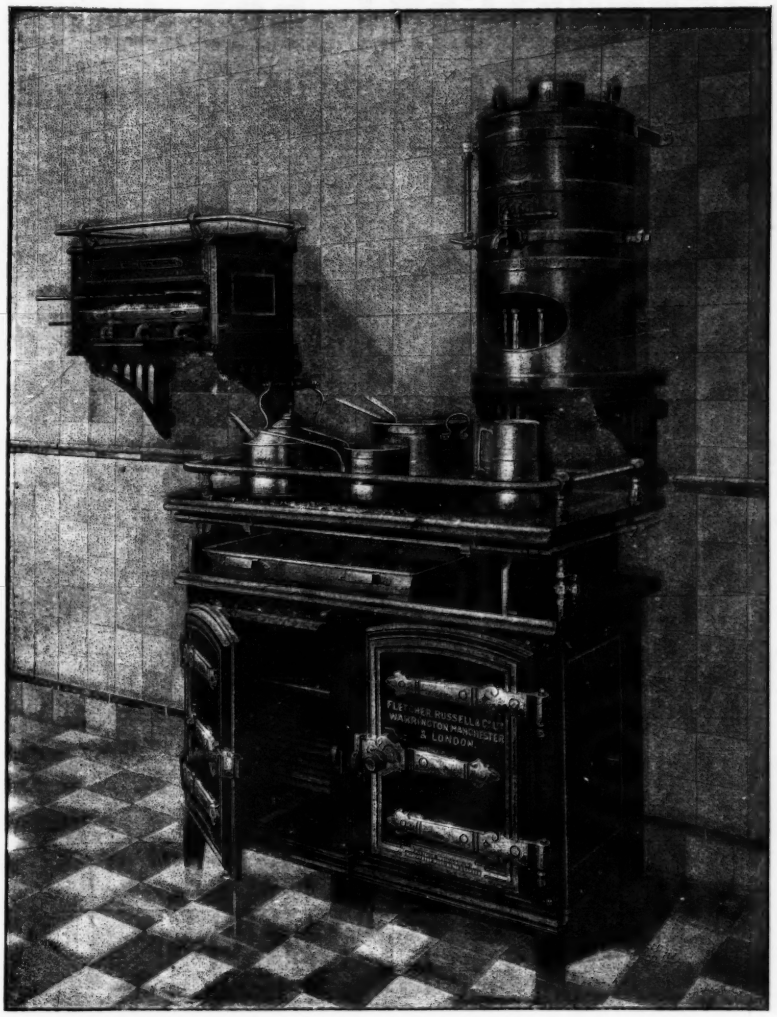

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ALL FLASH-LIGHTS ABOLISHED.
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ALL LAMPS WIND, RAIN, AND DUST PROOF.
GREAT SAVING OF MANTLES.

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NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, so far as they relate to CAPITAL STOCKS, WILL BE CLOSED at Four o'clock p.m. on Tuesday, the 1st day of July next, and WILL BE RE-OPENED immediately after the Half-Yearly Ordinary General Meeting of the Company to be held on the 1st day of August next.

By order,
JOHN WILLIAM FIELD,
Secretary and General Manager.

Chief Office: Horseferry Road,
Westminster, S.W., June 20, 1902.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held PERIODICALLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by AUCTION of GAS and WATER STOCKS and SHARES under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
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NEW ISSUE OF 300 £10 ORDINARY SHARES and £3000 FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, July 8, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
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NEW ISSUE OF 140 £25 "D" SHARES.

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By order of the Directors of the
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NEW ISSUE OF 600 £5 ADDITIONAL SHARES.

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By order of the Directors of the
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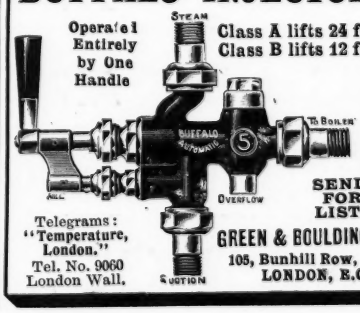

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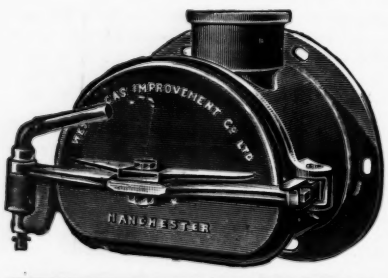

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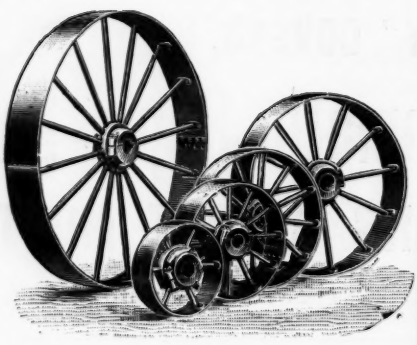

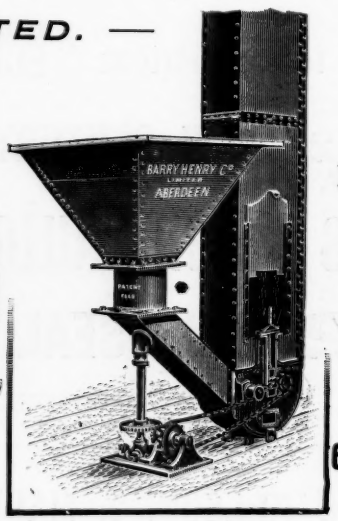

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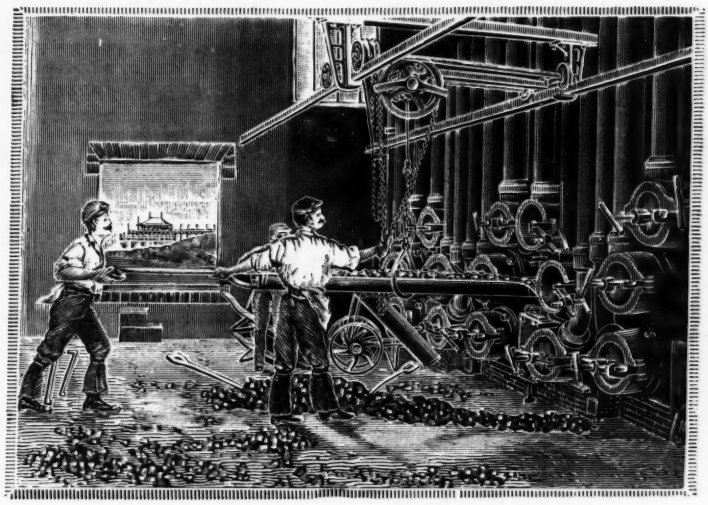

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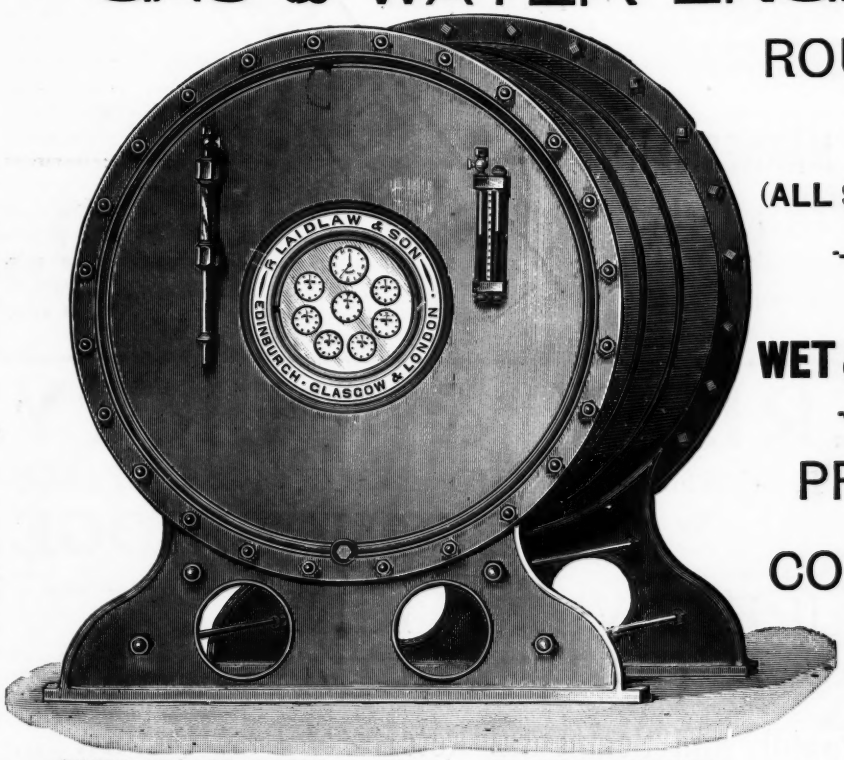

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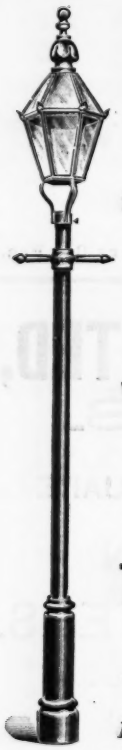

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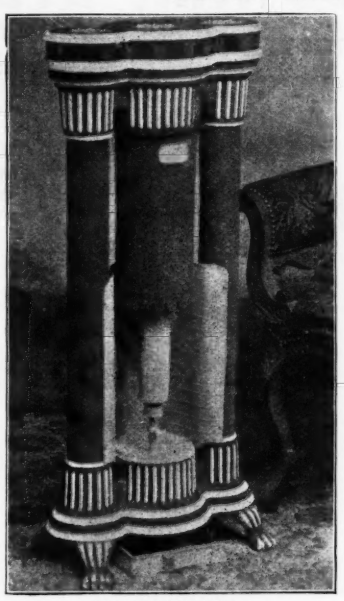

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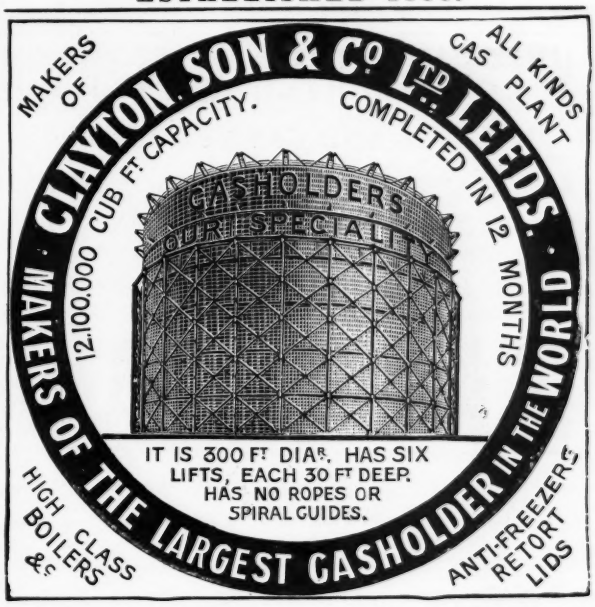
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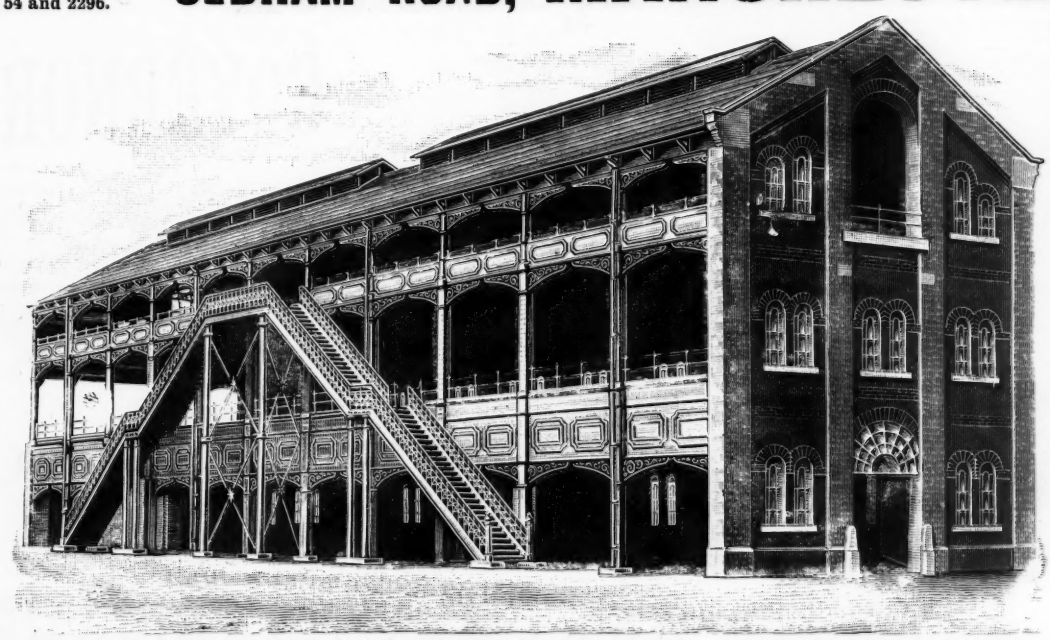

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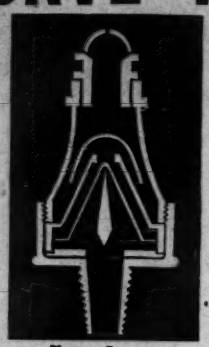

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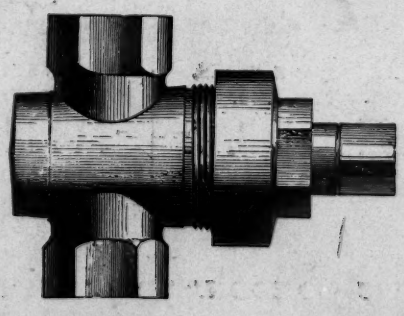

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